Manual of Operation and Instruction

Model 3241 Series Asphalt Content Gauges

Troxler Electronic Laboratories, Inc.
3008 E. Cornwallis Road • P.O. Box 12057
Research Triangle Park, NC 27709 U.S.A.
Phone: 1.877.TROXLER
Outside the U.S.A.: +1.919.549.8661
Fax: +1.919.549.0761
www.troxlerlabs.com

Troxler products are protected by U.S. and foreign patents.

Copyright © 1989 - 2011

Troxler Electronic Laboratories, Inc.

All Rights Reserved

No part of this manual may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording, or information storage and retrieval systems, for any purpose without the express written permission of Troxler Electronic Laboratories, Inc.

PN 104575
Edition 13
February 2012

TROXLER SERVICE CENTERS

Troxler Corporate Headquarters
P.O. Box 12057
Research Triangle Park, NC 27709
Phone: 1.877.TROXLER (1.877.876.9537)
Outside the U.S.A.: +1.919.549.8661
Fax: +1.919.549.0761

Technical Support
Phone: 1.877.TROXLER
(1.877.876.9537)
TroxTechSupport@troxlerlabs.com

North Carolina Service Center
3008 E. Cornwallis Road
Research Triangle Park, NC 27709
Phone: +1.919.549.8661
Fax: +1.919.549.0761
TroxTechSupport@troxlerlabs.com

Florida Office & Service Center
2376 Forsyth Road
Orlando, FL 32807
Phone: +1.407.681.4221
Fax: +1.407.681.3188
TroxTechSupport@troxlerlabs.com

Midwestern Office & Service Center
1430 Brook Drive
Downers Grove, IL 60515
Phone: +1.630.261.9304
Fax: +1.630.261.9341
TroxTechSupport@troxlerlabs.com

Western Office & Service Center
11300 Sanders Drive, Suite 7
Rancho Cordova, CA 95742
Phone: +1.916.631.0234
Fax: +1.916.631.0541
TroxTechSupport@troxlerlabs.com

Southwestern Office & Service Center
2016 East Randol Mill Rd., Suite 406
Arlington, TX 76011
Phone: +1.817.275.0571
Fax: +1.817.275.8562
TroxTechSupport@troxlerlabs.com

Troxler Europe & Service Center
Troxler Electronics GmbH
Gilchinger Strasse 33 D.82239
Alling nr. Munich, Germany
Phone: ++ 49.8141.71063
Fax: ++49.8141.80731
troxler@t-online.de

Troxler Electronic Technologies (Zhangjiagang)
1F, Bldg G, No. 1 Guotai North Road
ZJG, China, 215600
Phone: 0086.512.56793702
Fax: 0086.512.56793701
kjin@troxlerlabs.cn

To locate an independent, Troxler-authorized service partner near you, call 1.877.TROXLER (1.877.876.9537).

HOW TO USE THIS MANUAL

Congratulations on the purchase of the Troxler Model 3241 Series Asphalt Content Gauge.

The *Model 3241 Series Manual of Operation and Instruction* contains information on setting up and operating the gauge. Basic parameter set up, sample preparation, reading storage and advanced operation are included. Basic maintenance and troubleshooting are also included to keep the gauge in the best condition possible.

CONVENTIONS USED IN THIS MANUAL

Throughout this manual the following symbols and special formatting are used to reveal the purpose of the text.

WARNING

Warnings indicate conditions or procedures that, if not followed correctly, may cause personal injury.

CAUTION

Cautions indicate conditions or procedures that, if not followed correctly, may cause equipment damage.

NOTE

Notes indicate important information that must be read to ensure proper operation.

⟨**KEY**⟩ This style indicates a key or character on the keypad.

1. Indicates a procedure with multiple steps.

♦ Indicates a list of things needed (such as equipment) or important points to know.

► Indicates that more than one option is available. Carefully select the option that applies.

TABLE OF CONTENTS

CHAPTER 1: GENERAL INFORMATION

Introduction 1-2
Unpacking and Inspection 1-4
Site Selection 1-6

CHAPTER 2: THEORY OF OPERATION

Theory 2-2

CHAPTER 3: OPERATING THE GAUGE

Turning the Gauge On 3-2
Setting Parameters 3-4
Taking Background Counts 3-7
Preparing Samples 3-8
Taking a Measurement 3-9

CHAPTER 4: CALIBRATIONS

Equipment Needed 4-2
Preparing Calibration Samples 4-3
Sample Mixing 4-5
Performing the Calibration 4-10
Reviewing a Calibration 4-14
Enabling a Stored Calibration 4-15
Manually Entering Calibration Data 4-16

CHAPTER 5: PROJECTS

The Project Function 5-2
Storing a Measurement 5-4
Printing Measurement Data 5-5
Erasing a Project 5-6

CHAPTER 6: SHIFT FUNCTIONS

Introduction 6-2
Status 6-3
Offset 6-4
Special 6-8
Project 6-8
Auto-Store / Auto-Print 6-8
Erase 6-9
Recall 6-10
Target Precision 6-10
Calculator 6-11
Calibration Sample Preparation 6-12

CHAPTER 7: SPECIAL FUNCTIONS

Stat Test 7-2
Drift Test 7-4
Recover Erase 7-6
Time/Date 7-6
Calibration Transfer 7-7
Baud Rate 7-14
Customer Name 7-15
Serial Number 7-15
Pan Weight Display 7-16

APPENDIX A: RADIOLOGICAL INFORMATION

Radiation Theory A-2
Radiation Safety A-7
3241-C (100 mCi) Radiation Profile A-10
3241-C (300 mCi) Radiation Profile A-11
3241-D (80 mCi) Radiation Profile A-12
Source Encapsulation A-13

APPENDIX B: SPECIFICATIONS

Measurement Specifications B-2
Radiological Specifications B-3
Electrical Specifications B-4
Mechanical Specifications B-5

APPENDIX C: MAINTENANCE & TROUBLESHOOTING

Troubleshooting C-2
Leak Testing C-5
Battery Charging C-6
Replacement Parts C-7
Returning the Gauge for Service C-9

APPENDIX D: TRANSPORTATION & SHIPPING

U.S. Shipping Requirements D-2
Canadian Shipping Requirements D-4

APPENDIX E: SPECIAL CALIBRATION SAMPLES

Sealed Asphalt Samples E-2

APPENDIX F: CALIBRATION FORMS

INDEX

WARRANTY

LIST OF FIGURES

Figure 1. Gauge Parts 1-3
Figure 2. 3241 Connections 3-2
Figure 3. Filling the Blank Sample Pan 4-4
Figure 4. Sample Slope Offset Graph 6-5
Figure 5. Example Relative Offset Graph 6-5
Figure 6. Example Slope/Intercept Offset Graph 6-6
Figure 7. Sample Stat Test Printout 7-5
Figure 8. Serial Device Connection 7-14
Figure 9. Diagram of an Atom A-3
Figure 10. Variation of Radioactive Emission A-6
Figure 11. Effect of Distance on Exposure A-9
Figure 12. 3241 (100 mCi) Radiation Profile A-10
Figure 13. 3241 (300 mCi) Radiation Profile A-11
Figure 14. 3241-D (80 mCi) Radiation Profile A-12
Figure 15. Sealed Asphalt Sample E-3
Figure 16. Calibration Data Sheet F-4

LIST OF TABLES

Table 1. Shift Combinations.....6-2
Table 2. Range of Standard Deviation Ratios.....7-2

Chapter 1:
General Information

This chapter covers the following topics and tasks:

- ✓ Introduction
- ✓ Gauge parts and accessories
- ✓ Unpacking and inspection
- ✓ Site selection

Introduction

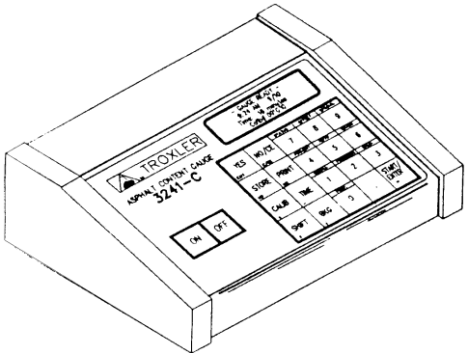
The Model 3241 Series gauges can quickly and precisely determine the asphaltic cement (or bitumen) content of an asphalt-aggregate mix without the use of volatile or hazardous chemicals. Using the proven principle of neutron thermalization, the gauge determines asphalt content. Hydrogen in the asphalt slows neutrons emitted from an Americium-241:Beryllium source. A series of Helium-3 detectors located in the base detects the slowed neutrons and the gauge converts the count into a precise measurement of asphalt content.

The gauge may be calibrated to accommodate different mixes and the calibrations may be transferred to other gauges. The sample temperature is always monitored allowing the gauge to compensate for variations which have been known to cause problems in other gauges.

The nuclear method of asphalt content testing has been approved by the American Society of Testing and Materials (ASTM) and the Model 3241 Series gauges meet or exceed all the requirements of ASTM D-4125-10, *Standard Test Method for the Asphalt Content of Bituminous Mixtures by the Nuclear Method*.

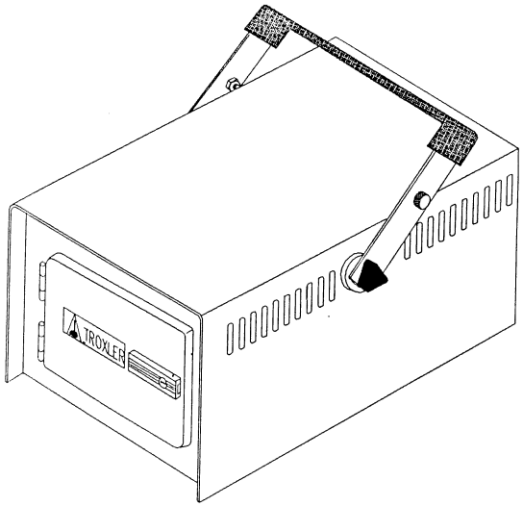
Owners are encouraged to require study of this manual by operator(s) before allowing any use of the instrument. While no radiation hazard exists for operator(s) during normal use, a potential hazard does exist if improperly used. The sections of the manual covering radiological safety should be required reading for all operators and potential operators. If these sections are not completely understood, seek assistance from a Troxler representative. Additional nuclear safety information is available in the Troxler Nuclear Gauge Safety training course. Visit our website at www.troxlerlabs.com for more information.

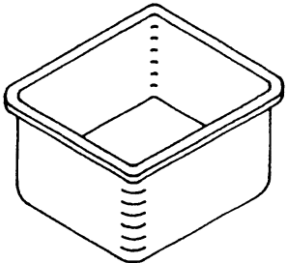
As changes are made to local, state and federal regulations on a continuing basis, the owner/user must maintain a current status with these regulations. The responsibility for compliance ultimately falls upon the owner. The owner may also wish to purchase and subscribe to Titles 10 and 49 of the Code of Federal Regulations in addition to applicable local/state regulations.



Control Unit

Sample Chamber





Sample Pans (4)

Control Unit/Chamber
Interface Cable

Figure 1. Gauge Parts

Unpacking and Inspection

Unpacking

Upon receipt of the gauge from the factory, perform a complete inspection and inventory. If the shipping case or any other part of the container is damaged contact the shipper immediately. Save the box and any packing material for possible shipment of the gauge to another location or back to the factory.

Inspection

After removal from the transport case from the cardboard box, check to see if the following have been included (the first four are shown in Figure 1 on the previous page).

- Control Unit – provides the operator interface to the system. The console contains the keypad, display and the microprocessor used to process the sample data.
- Sample Chamber – contains the radioactive source, the detectors and the high voltage electronics used for measuring the asphalt content of the sample.
- Sample Pans (4) – used to hold an exact amount of asphalt for testing. Four pans are supplied with the gauge.
- Control Unit/Chamber Interface Cable – connects the console to the sample chamber.
- Documentation (manual of operation and instruction; source certificate; data sheet; transportation guide).
- Power Adapter – connects the gauge to a 115/230 VAC, 50/60 Hz power source.
- Power Adapter (DC Charger).
- Optional Serial Printer connects to the control unit for printing sample data.
- Water Resistant Transport Case – a DOT-approved shipping container for the sample chamber and control unit.

- Serial Interface Cable (optional accessory) connects the gauge to a printer or computer.

Lift the gauge from the case and inspect the outside surface for damage. Check the lock on the sample chamber. Make sure the keys fit the lock. Return the gauge to the transport case.

If the gauge appears to be damaged notify the carrier and your Troxler representative immediately.

Site Selection

When choosing a gauge location site, take into consideration the ambient temperature and location of power outlets, large objects and any other nuclear gauges.

- Ensure that the room where the gauge is to be located is well ventilated and does not experience abrupt temperature or humidity changes.
- Place the gauge on a level, sturdy surface.
- Install the gauge with the control unit within reach of the operator's workstation and the sample chamber, connected to the control unit, readily accessible for sampling. The background count will account for any external hydrogen sources (Chapter 3: Operating the Gauge). If the system is moved or objects containing hydrogen and/or larger objects are moved near the sample chamber after taking the background count, a new background count should be taken.
- Do not stand close to the sample chamber due to possible measurement effects and radiation safety.
- The line voltage should not vary by more than ±10%.
- The ambient temperature should be between 10 and 33 °C (50 - 91 °F), and the relative humidity should be between 20 and 90 percent.
- The gauge must be installed at least ten meters (33 feet) from any other nuclear gauge.
- Do not expose the gauge to open flames, dust, direct sunlight, or ammonia and other corrosive fumes.

Chapter 2:
Theory of Operation

This chapter covers the following topics and tasks:

- ✓ Operating principles

Theory

The Model 3241 Series Asphalt Content Gauges measure the amount of asphalt (bitumen) in a bituminous mixture by determining the hydrogen content of the material. The amount of asphalt and the amount of moisture can be related to hydrogen content since both contain hydrogen.

In all 3241 configurations, the fast neutrons emitted are thermalized (slowed) by the hydrogen in the asphalt. The Helium-3 detectors located in the gauge detect the slowed neutrons, since helium-3 detectors are insensitive to fast neutrons. The thermalized neutrons are counted over time and this "count" is proportional to the asphalt content of the sample.

Chapter 3:
Operating the Gauge

This chapter covers the following topics and tasks:

- ✓ First-time setup
- ✓ Taking background counts
- ✓ Preparing samples
- ✓ Taking measurements

Turning the Gauge On

Figure 2 shows all 3241 connections. Connect the sample chamber to the control unit with the main interface cable. Connect the power adapter to the control unit and a 120 VAC outlet.

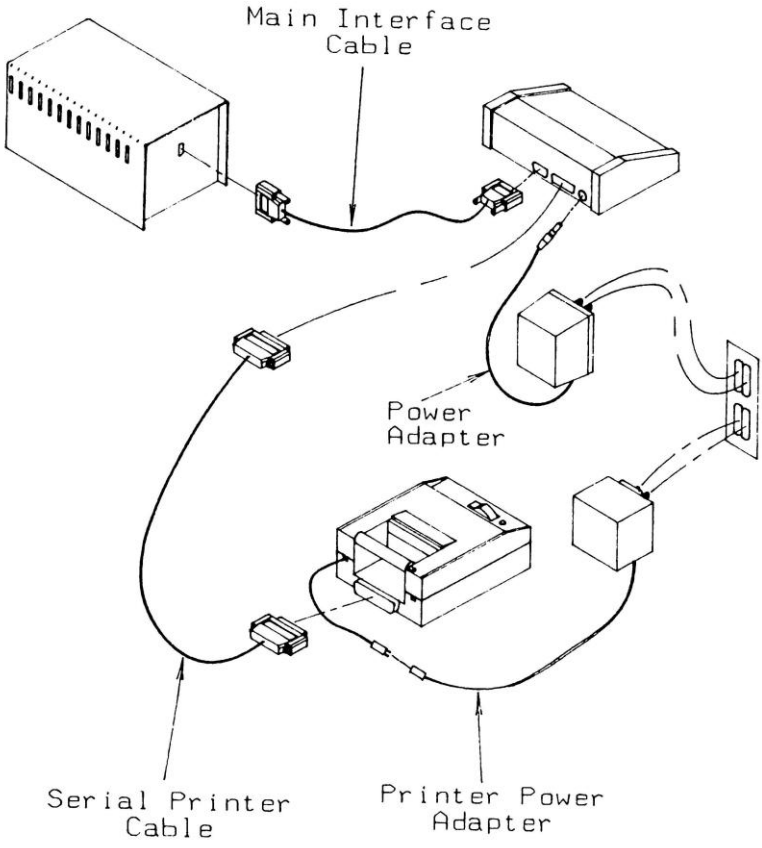
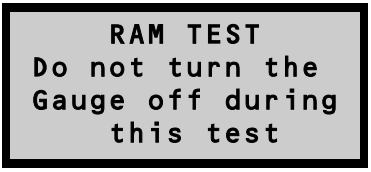
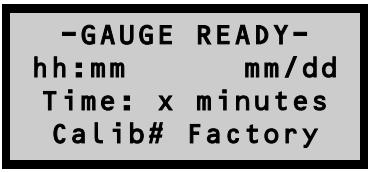


Figure 2. 3241 Connections

Turn the gauge on by pressing ⟨**ON**⟩.



After the RAM test the gauge will enter the 120-second Self Test. In this mode the version number and customer name are displayed. After the test the display will be:



The second line displays the time and date. The third line displays the count time. The last line displays the current enabled calibration.

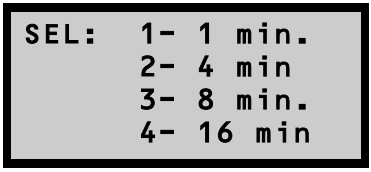
Setting Parameters

After unpacking and turning "On" the gauge, several parameters can be initialized. These parameters usually do not require changing and include the count time, time/date, and company name.

Setting the Count Time

Press ⟨**TIME**⟩ for the display:

To accept the displayed count time, press ⟨**ENTER**⟩. To change the displayed count time, press ⟨**YES**⟩.



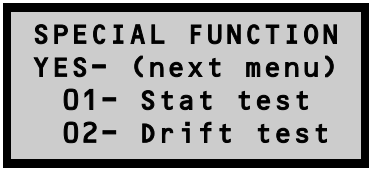
Make the selection by pressing the number that corresponds to your selection. The display will return to the *Ready* mode.

NOTE

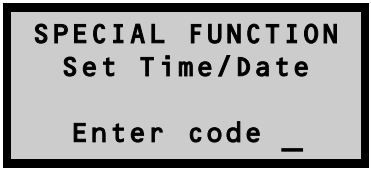
The longer the count time the better the measurement precision.

Setting the Time/Date

Press ⟨**SHIFT**⟩ and ⟨**9**⟩ for the *Special* menu. The display will be:



To select this feature, press ⟨**4**⟩.



The Time/Date function is a restricted function and requires an access code for operation. This is to ensure that the time and date are not changed by unauthorized personnel.

Input the access code and press ⟨**ENTER**⟩. The display will be:

- To accept the displayed date, press ⟨NO⟩.
- To change the date, press ⟨**YES**⟩.

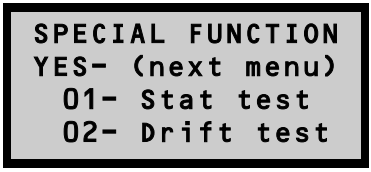
Select the format to be used: *dd/mm/yy* or *mm/dd/yy*.

Input the new date and press ⟨**ENTER**⟩. To change the time, repeat the above procedure.

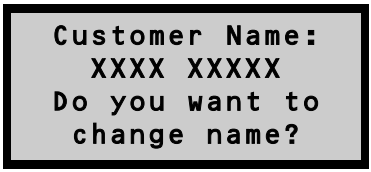
Changing the Customer Name

The gauge may be programmed to display your name or any other message (not to exceed 16 characters) during the power-up / self-test stage.

Press ⟨**SHIFT**⟩ and ⟨**9**⟩ for the *Special* menu. The display will be:



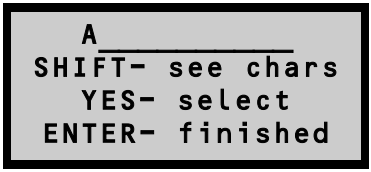
Scroll through the menu options by pressing ⟨**YES**⟩ twice. Select *Customer Name* by pressing ⟨**7**⟩.



To change the customer name, press ⟨**YES**⟩.

The Customer Name function is a restricted function and requires an access code for operation. This is to ensure that the name/message is not changed by unauthorized personnel.

Input the access code and press ⟨**ENTER**⟩. The display will be:



To scroll up through the letters, press ⟨**SHIFT**⟩. To scroll down through the letters, press ⟨**TIME**⟩.

To select the letter and move to the next position, press ⟨**YES**⟩. Complete the operation by pressing ⟨**ENTER**⟩.

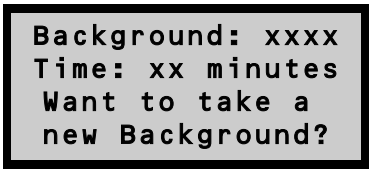
Taking Background Counts

Prior to performing any testing, measuring, or calibrating with the gauge, take a *background count*. The background count adjusts for changes in the gauge environment and location.

The Model 3241 gauge is influenced by external sources of hydrogen. Once a background count is made, do not change the surrounding sources of large hydrogen content (e.g., draining a water bath, moving large containers of liquids). Take a new background count if changes occur or are suspected. During and after a background count the test samples should not be within 1 meter (3 feet) of the sample chamber.

The neutron source used in the gauge is Americium-241:Beryllium and has a half-life of 432 years (or will undergo a natural decay of 0.2% per year). The background count also adjusts for source decay.

Press ⟨**BKG**⟩ for the display:



To take a new background count, press ⟨**YES**⟩.

Prepare the sample chamber as instructed and press ⟨**START**⟩.

After the count is complete and acceptable, press ⟨**YES**⟩. To take another background count, press ⟨**NO**⟩.

Preparing Samples

NOTE

Prior to measuring asphalt content, the gauge must contain a calibration corresponding to the asphalt samples to be tested (see Chapter 4:). The percent (%) asphalt of the test samples must be within the range of the gauge calibration (see the example on page 4-3).

To prepare measurement samples:

1. Obtain the weight of an empty sample pan using an accurate balance scale or electronic scale. Record the pan weight.
2. Partially fill (1/3 full) the pan with the asphalt mix. Lightly tamp the mix with a spoon or spatula. Do not pack the material with a press or hammer.
3. Continue adding hot asphalt in layers, settling and tamping each layer until the pan is full and the asphalt is above the pan top. The asphalt sample should be level with the top of the pan, so place a piece of wax paper over the asphalt and press down on the sample with a wooden board or other flat object.
4. Remove the wax paper and place the full sample pan on the scale and obtain the weight. Record the value.
5. Repeat the above procedure for each sample. Make sure each sample has the same weight (±4 g).
6. Take a measurement as described the following section.
7. Upon measurement completion, remove the asphalt from the sample pan by reheating the pan in an oven. Turn the pan upside down and lightly tap on the bottom. **Do not dent the bottom of the pan!**

NOTE

Ensure measurement consistency by marking the sample pans so they are inserted into the chamber the same way eat time the pan is used.

Place the asphalt sample into the test chamber and close the door.

If the *Pan Weight Display* function is enabled, the gauge will request the weight of the empty sample pan and the weight of the pan containing asphalt (see page 7-16).

Enable the appropriate mix calibration by pressing ⟨**CALIB**⟩.

Press ⟨**START**⟩ to begin the measurement sequence. The display will be:

```
Calib# XXX.XX
Input empty pan
weight: ____ g.
and press ENTER
```

Input the recorded empty sample pan weight and press ⟨**ENTER**⟩.

```
Fill Sample Pan
until weight =
    XXX g.
(Press ENTER)
```

Make sure the unknown % asphalt content sample is the same weight as the calibration samples (±8 g) for the mix being tested.

Press ⟨**START**⟩ for the display:

The gauge will count down as the asphalt content measurement is obtained. After the count time has elapsed, the results will be displayed. For storing results, refer to Chapter 5.

Chapter 4: Calibrations

This chapter covers the following topics and tasks:

- ✓ Preparing calibration samples
- ✓ Performing calibrations

Equipment Needed

In order to obtain precise asphalt content measurements, use a consistent method of sample preparation. Using the same approved equipment for preparing each sample helps ensure the best possible results.

Necessary Equipment

The following equipment will be needed during calibration and test sample preparation:

- Balance/Electronic scale readable to 1 g (0.002 lb).
- Drying oven, capable of heating to 177°C (350°F).
- Two 76 x 30 x 6 cm (30 x 12 x 2.5 in.) stainless steel utility pans.
- (2) 41 cm (16 in.) stainless steel mixing bowls.
- Steel straightedge, approximately 20 cm (8 in.) long.
- Plywood or metal plate having an area slightly larger than the sample pans.
- Thermometer with temperature range of 10° to 260°C (50° to 500°F).
- Assorted spoons, spatulas, heat resistant gloves, etc.

Suggested Equipment

The following equipment will aid mixing and sample preparation:

- Large commercial grade electric blender with a mixing bowl capable of holding a sample weighing up to 10 kg (22 lb).
- Heated asphalt reservoir with temperature control.

Preparing Calibration Samples

Follow the procedures outlined below to prepare asphalt samples for gauge calibration.

Preparing Blank Samples

Before preparing calibration samples, prepare a *blank sample* of aggregate to estimate the asphalt sample size or to adjust the calibration for changes in aggregate size or moisture content.

1. Obtain enough sample of the aggregate(s) being used in the asphalt mixture for a minimum of three samples. For each calibration sample, obtain a minimum of 9 kg (20 lbs) of aggregate. Refer to AASHTO Standard Method T2.
2. Obtain a sample of the liquid asphalt (bitumen) being used in the mixture. For each calibration sample, obtain at least 1.4 kg (3 lbs). Refer to AASHTO Method T168.
3. Blend the aggregate(s) in the proper proportions (or obtain blended aggregate samples). The aggregate should be maintained at the proposed plant temperature or placed in an oven and baked for 3 hours at 121°C (250°F) to remove any moisture.
4. Select an empty sample pan and obtain the weight (tare weight) using a balance or electronic scales.
5. Fill the sample pan about half-full with dry, hot aggregate (see Figure 3).
6. Settle the aggregate by dropping the pan about one inch onto a hard surface several times.
7. Smooth the aggregate mixture into the corners of the pan.
8. Fill the rest of the pan with aggregate, overfilling slightly.
9. Scrape off the surface with the straightedge.

DO NOT COMPACT THE SAMPLE WITH A COMPACTION TOOL!

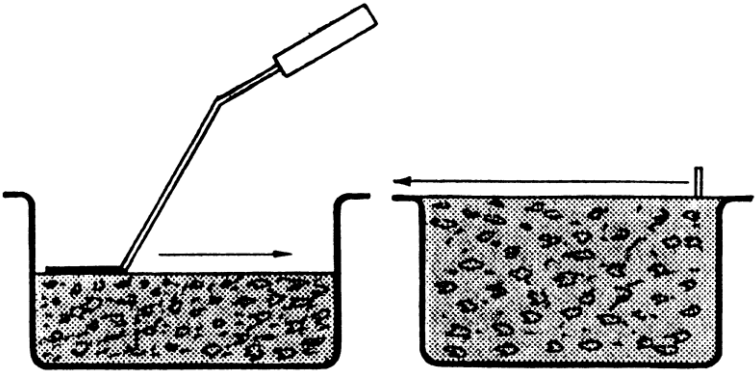


Figure 3. Filling the Blank Sample Pan

10. Place the filled sample pan on the balance or electronic scale and record the weight.

11. Subtract the weight of the empty pan to obtain the weight of the aggregate only.

Example	
Weight of Sample Pan with aggregate	7387 g
Less: Weight of empty sample pan	- 571 g
Net Weight of Aggregate	6816 g

12. Place the aggregate-only sample back in the oven and reheat to the proposed plant temperature.

13. Measure this sample using a 16-minute count time. Record this count on the calibration form (see Appendix F).

Sample Mixing

The calibration samples can be mixed after preparing the blank sample. For the best measurement accuracy, each sample of asphalt mixture (calibration and production testing samples) should be the same weight (±4 g).

After determining the % asphalt content (%AC) for the known calibration sample (see example below), prepare the highest %AC sample first. Fill the pan as full as possible, determine the weight and prepare all samples at this weight (±4 g).

Calibration samples are prepared by mixing a known weight of hot, dry aggregate with a known weight of hot, liquid asphalt. The number of calibration samples is optional and may vary from two to twelve, with twelve providing the best accuracy. Calibration samples should be prepared with the asphalt content above and below the design content.

Example: If the Design Mix is 5.5% asphalt content and five calibration samples are to be used, then the asphalt content of the calibration samples should be 4%, 4.8%, 5.5%, 6.2%, and 7%.

```
E~=~D~+~Left ( {A~*~C} OVER 100 Right )
```

Two methods for expressing the asphalt content percentage:

Method 1: % Asphalt by Aggregate Dry Weight

Method 2: % Asphalt by Total Mix Weight

```
E~=~D~+~Left ( {A~*~C} OVER {100~-~A} Right )
```

where: A = % Asphalt Content

C = Dry Aggregate Weight

D = Weight of Mixing Bowl + Dry Aggregate

E = Total Design Weight

Mixing Tips

- Prepare more asphalt than needed!
- It is recommended that the aggregate weight of the sample be equal or exceed that of the blank sample to ensure the preparation of slightly more asphalt than needed.
- When preparing a calibration mix, the aggregate and asphalt must be representative of the material normally produced by the asphalt plant. If the mix is not representative, the gauge readings will not accurately reflect the actual asphalt content.
- All mixing tools should be kept hot to prevent moisture from contaminating the mixture and to make mixing easier. Placing the mixing bowl on a hot plate will aid in mixing.
- Form a "crater" in the hot aggregate. Slowly pour the hot asphalt into the crater and mix until the aggregate is thoroughly distributed. Mixing time is approximately 15 minutes. If using an electric mixer, mixing time at medium speed is about 90 seconds.

Mixing Procedure

Use the calibration forms in Appendix F to record the values.

1. Heat a mixing bowl and asphalt.
2. Smear a small amount of hot, liquid asphalt and aggregate fines in the bowl.
3. To ensure any residual asphalt in the bowl represents the design mix, scrape out the bowl.
4. Weigh the mixing bowl and record the weight on line B of the form. If available, use the *tare* function on the scale to "zero" the bowl weight.
5. Put hot, dry aggregate (see *Mixing Tips*, above) into the preheated mixing bowl. Use the same type of aggregate as in the blank sample. Record the weight on line C.
6. Add lines B and C. and enter the subtotal on line D.
7. Use the Method 1 or Method 2 formula on the previous page to calculate the total design weight. Use the method that duplicates the asphalt plant method. Enter the weight on line E.
8. Slowly add hot asphalt to the aggregate until the total design weight is reached. If the actual weight is slightly over or under the design weight, record the value on line F.
9. Calculate the actual %AC (see example below) and enter the value on line G.

For Method 1, use the following equation:

G~=~100~*~Left ({F~-~D} over C Right)

where: C = Weight of Dry Aggregate (line C)

D = Mixing Bowl+Dry Aggr Weight (line D)

F = Total Actual Weight (line F)

G = Actual Asphalt Content (%)

For Method 2, use the following formula:

G~=~{(~ 100~*~(F-D)~)} over {(~C~+~(F-D)~)}

where: C = Weight of Dry Aggregate (line C)

D = Mixing Bowl + Dry Aggr. Weight (line D)

F = Total Actual Weight (line F)

G = Actual Asphalt Content (%)

Filling Sample Pans

Filling Tips

- Level t he mixture on the top of the sample pan, spreading the mixture out to the edges of the pan. The calibration sample may be compressed with a piece of flat wood or flat metal plate to ensure that the asphalt is level with the top of the pan. **Do not compact the sample with a press or compaction tool!**
- Place a piece of wax paper over the pan to prevent the asphalt from sticking to the flat plate.

Filling Procedure

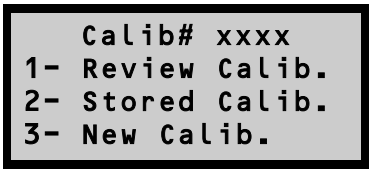
Use the forms in Appendix F to record the values.

1. Weigh the empty sample pan and enter the value on line H
2. Write the sample number and pan weight on the pan.
3. Enter the weight of the blank sample (line 3) on line J.
4. Add lines H and J and enter the total on line K.
5. Write the actual %AC (line G) on line L.
6. Place the preheated sample pan on a table and fill about 1/3 full (see *Filling Tips*).
7. Settle the asphalt mixture by tapping the pan on the table.
8. Lightly press the mixture with a spoon or spatula.
9. Continue adding the mixture in three layers, settling and tamping each layer until the sample pan is full.
10. Place the sample pan on the scales and add or remove material until the weight equals the weight on line K.

Performing the Calibration

After preparing all calibration samples, the calibration can be performed for the design mixture. This procedure refers to the calibration forms in Appendix F.

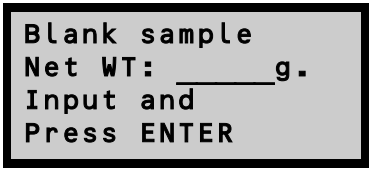
To access the *Calibration* function, press ⟨**CALIB**⟩.



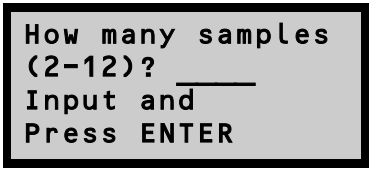
For a new calibration, press ⟨**3**⟩.

- To manually enter calibration data, press ⟨**1**⟩. This option is commonly used to re-enter previously accumulated calibration data.
- To perform a new calibration, press ⟨**2**⟩.

The gauge will prompt for a new background count. Press ⟨**YES**⟩. After accepting the count, the display will request the weight of the blank sample. The net weight is on line 3.



The gauge will request the number of calibration samples.

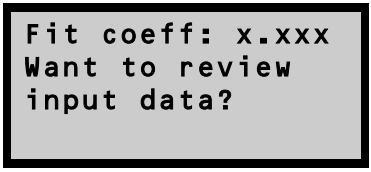


Input the number of samples and press ⟨**YES**⟩. The display will request the %AC of the first sample.

Input the %AC, from line G. Press ⟨**ENTER**⟩.

Place the first calibration sample in the sample chamber and press ⟨**START**⟩. Record the counts on line M.

Repeat the above procedure for each sample. After all samples have been measured the display will be:

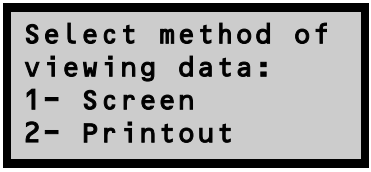


The gauge calculates the calibration curve and curve "fit." The "fit coefficient" is any number between 0.0 and 1.0, with 1.0 being a perfect fit.

After calculation of the fit coefficient, the data may be viewed.

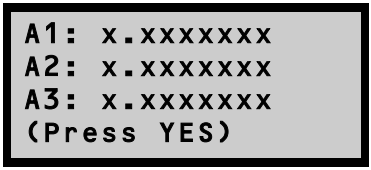
- To view data, press ⟨**YES**⟩ at the above display.
- If you do not want to review the data, press ⟨**NO**⟩ at the prompt.

The gauge proceeds to the calibration storage display.

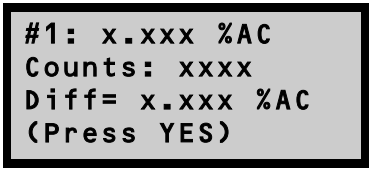


To view the data on the screen, press ⟨**1**⟩.

To scroll through the displays, press ⟨**YES**⟩.



Record the coefficients on the form in Appendix F. Press ⟨**YES**⟩.

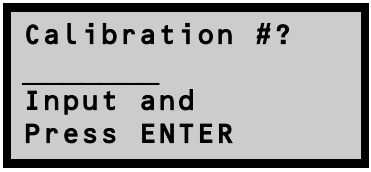


Continue to view the remaining samples by pressing ⟨**YES**⟩.

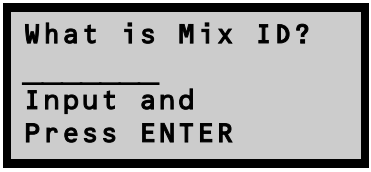
NOTE

"Diff" is the difference between the actual %AC entered and the %AC calculated from the calibration curve.

To store the calibration, press ⟨**YES**⟩.



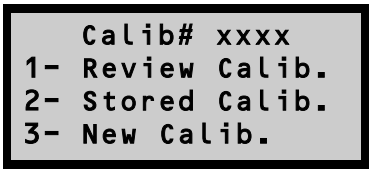
Input a calibration number. This number will be used to recall the calibration later. Press ⟨**ENTER**⟩.



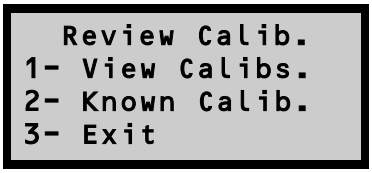
Input the asphalt mixture number and press ⟨**ENTER**⟩. The calibration will be stored and the gauge will return to the *Ready* mode.

Reviewing a Calibration

Calibrations stored in the gauge may be recalled and viewed later. To begin reviewing stored calibrations, press ⟨**CALIB**⟩.



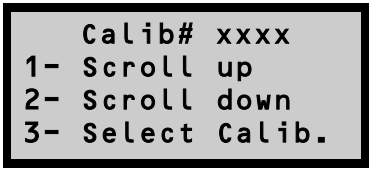
To review a calibration, press ⟨**1**⟩.



If the calibration number is known, press ⟨**2**⟩ and enter the number. The gauge displays the calibration data. To scroll through the data, press ⟨**YES**⟩.

After viewing all the calibration data, the gauge returns to the *Ready* mode.

To scroll through the calibration numbers, press ⟨**1**⟩.

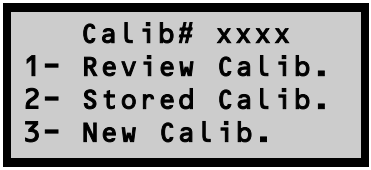


- If the calibration number shown on the display is not correct, press ⟨**1**⟩ or ⟨**2**⟩ to scroll through the list of calibrations.
- To select calibration for review, press ⟨**3**⟩. The gauge displays the data and returns to the *Ready* mode.

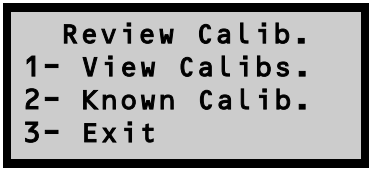
Enabling a Stored Calibration

Calibrations stored in the gauge may be enabled later.

To access the *Calibration* feature, press ⟨**CALIB**⟩.

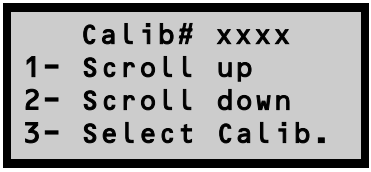


To activate/enable an existing calibration, press ⟨**1**⟩.



If the calibration number is known, press ⟨**2**⟩ and enter the number. The gauge will indicate the activation and return to the *Ready* mode.

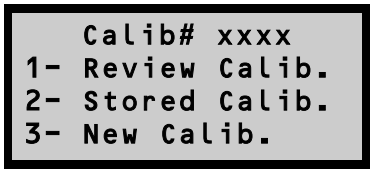
To view the list of calibrations, press ⟨**1**⟩.



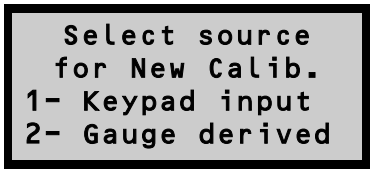
- Scroll through the calibration numbers by pressing ⟨**1**⟩ or ⟨**2**⟩.
- Select the calibration number displayed by pressing ⟨**3**⟩.

Manually Entering Calibration Data

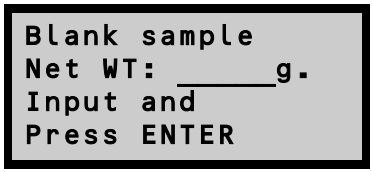
To access the *Calibration* feature, press ⟨**CALIB**⟩.



To enter calibration constants, press ⟨**3**⟩.



Press ⟨**1**⟩. The gauge displays:



Input all information requested by the gauge.

Chapter 5: Projects

This chapter covers the following topics and tasks:

- ✓ Using the *Project* function
- ✓ Storing measurements
- ✓ Printing measurement data
- ✓ Erasing projects

The Project Function

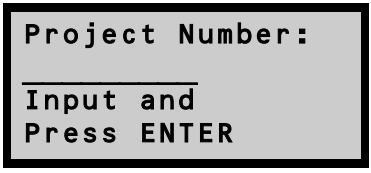
Data is stored in the gauge under a project number. When a project is active, all readings are stored under this project number. This feature allows data retrieval and printing or downloading to a computer.

The *Project* function allows projects to be created and viewed.

Create a New Project

Press ⟨**SHIFT**⟩ and ⟨**4**⟩ for the Project display:

Press ⟨**3**⟩ for the display:



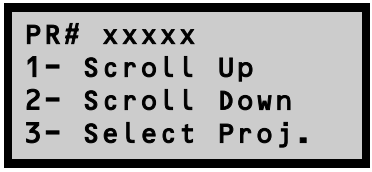
Input a project number (up to 12 numbers) and press ⟨**ENTER**⟩. After a brief delay the display will be:

The gauge will return to the *Ready* mode.

View an Existing Project

Press ⟨**SHIFT**⟩ and ⟨**4**⟩ for the display:

- If the project number is known, press ⟨**2**⟩ and see the third display on this page.
- To view the project numbers, press ⟨**1**⟩.



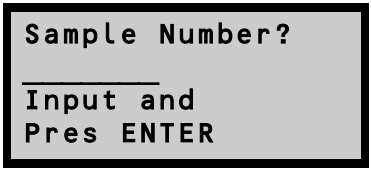
- To scroll through the list of projects, press ⟨**1**⟩ or ⟨**2**⟩.
- To select the project for viewing, press ⟨**3**⟩.

- To display the first data stored under the project number, press ⟨**1**⟩.
- To display the most recent data stored under the project, press ⟨**2**⟩.
- To exit to the *Ready* mode, press ⟨**3**⟩.

Storing a Measurement

After taking a measurement the data may be stored under a project number for recalling and printing later.

Press ⟨**STORE**⟩. The display will be:

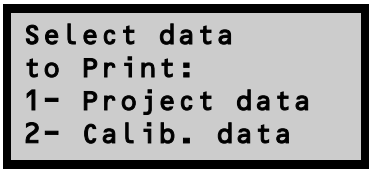


Input a sample number (up to 6 numbers) and press ⟨**ENTER**⟩. The asphalt sample data will be stored under the current project and sample number.

Printing Measurement Data

Project data may be printed at any time after taking and storing the readings. Data may be printed (uploaded) to a computer file, with the control unit connected to a personal computer using an interface cable. To download data to a computer, use Microsoft® HyperTerminal software program, included on Windows 95/98 machines (this software is not available or Windows Vista or 7).

Press ⟨**PRINT**⟩. The display will be:



Press ⟨**1**⟩. The display will be:

Connect the printer to the serial port located on the back of the console (refer to page 7-14 for information on setting the baud rate and the location of the serial port).

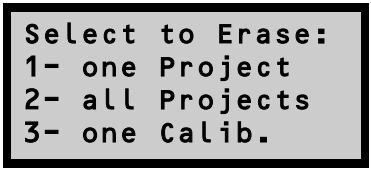
- To print all projects, press ⟨**2**⟩.
- To select a single project, press ⟨**1**⟩. The display is:

- Scroll through the project numbers by pressing ⟨**1**⟩.
- To input a known project number, press ⟨**2**⟩.

Erasing a Project

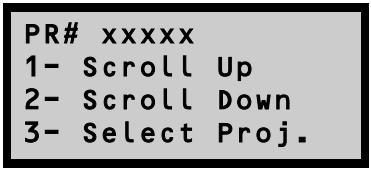
The *Erase* function allows project data (or a calibration) to be erased or removed from the gauge's memory.

To erase a project from memory, press ⟨**SHIFT**⟩ and ⟨**6**⟩ for:



- Erase all projects by pressing ⟨**2**⟩. At the erase prompt, press ⟨**SHIFT**⟩ and ⟨**YES**⟩. After erasing all projects, the gauge returns to the *Ready* mode.
- Erase a single project by pressing ⟨**1**⟩.

To view the project list, press ⟨**1**⟩. The gauge displays:



Scroll through the project list by pressing ⟨**1**⟩ or ⟨**2**⟩. Press ⟨**3**⟩ to select the project to erase. To erase the project, press ⟨**SHIFT**⟩ and ⟨**YES**⟩ at the prompt.

The gauge returns to the *Ready* mode.

Accidental Erasure

If data is accidentally erased, press ⟨**SHIFT**⟩ and ⟨**9**⟩ for the *Special* menu. Press ⟨**3**⟩ to select *Recover Erase*.

Chapter 6:
Shift Functions

This chapter covers the following topics and tasks:

- ✓ Using the functions enabled with the SHIFT key.

Introduction

This chapter gives brief explanations of the Shift functions available on the Model 3241 Series gauges. Functions are displayed on the numeric keys of the keyboard and are accessed by pressing ⟨**SHIFT**⟩ and the corresponding function key.

Table 1describes the function for each combination.

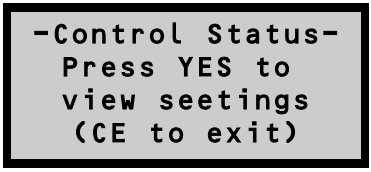
Table 1. Shift Combinations

SHIFT +	**FUNCTION**
0	PREP. – Allows the entry of the calibration values (see Chapter 4).
1	RECALL – Retrieves the results of the last reading.
2	PRECISION -
3	CALC. – Activates the calculator function.
4	PROJECT – Enables project functions (see Chapter 5)
5	AUTO – Automatically store or print data.
6	ERASE – Erases measurement and calibration data.
7	STATUS – View gauge settings without accessing the individual functions separately.
8	OFFSET – Provides a method for adjusting an existing calibration to obtain higher precision.
9	SPECIAL – Refer to Chapter 7 for special functions.

Status

The *Status* function allows you to view each setting without accessing the individual function.

Press ⟨**SHIFT**⟩ and ⟨**7**⟩ for the *Status* display:



- To view settings, press ⟨**YES**⟩ at each subsequent screen.
- Exit by pressing ⟨**NO/CE**⟩.

Offset

The *Offset* function provides a method for adjusting an existing calibration to obtain higher precision when it is not practical to perform a new calibration.

A calibration is performed using the specific materials found in the test samples. A new calibration ensures that the gauge will obtain the highest precision possible. Perform an offset only as an intermediate measure and if the materials vary slightly.

The Model 3241 Series offers three different types of offset adjustments: *slope*, *relative*, and *slope/intercept*. The calibration curve will be adjusted according to the offset selected.

Slope Offset

If the asphalt source changes and recalibration is not possible, a slope offset can be performed (Figure 4). This offset uses a selected calibration and a new offset sample of known %AC to recalculate the slope of the calibration curve. A slope offset will produce accurate results if the unknown samples are within 0.5%AC of the offset sample.

Relative Offset (%AC Shift)

This offset can be used to correlate gauge readings and extraction results. A relative offset adds or subtracts the offset to adjust the calculated value (Figure 5).

Relative Offset (Intercept)

If the aggregate moisture changes from the time the original calibration was performed, the intercept relative offset can be used. An offset sample of known %AC must be prepared and measured to provide the information relevant to this offset (see page 4-3).

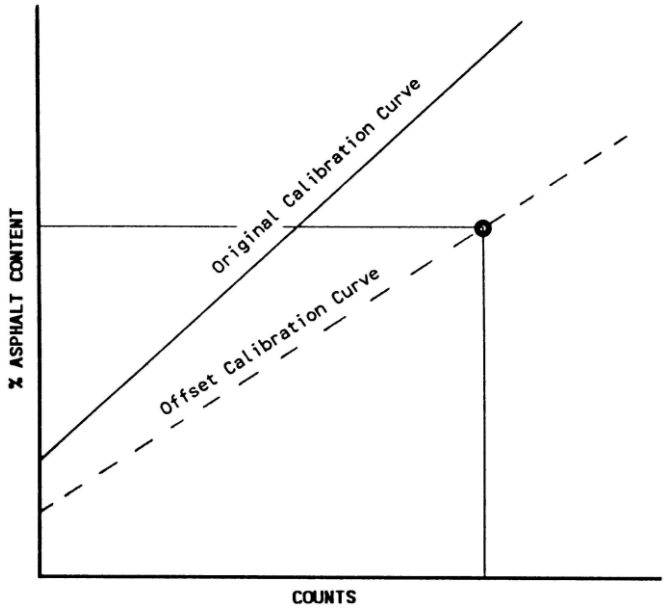


Figure 4. Sample Slope Offset Graph

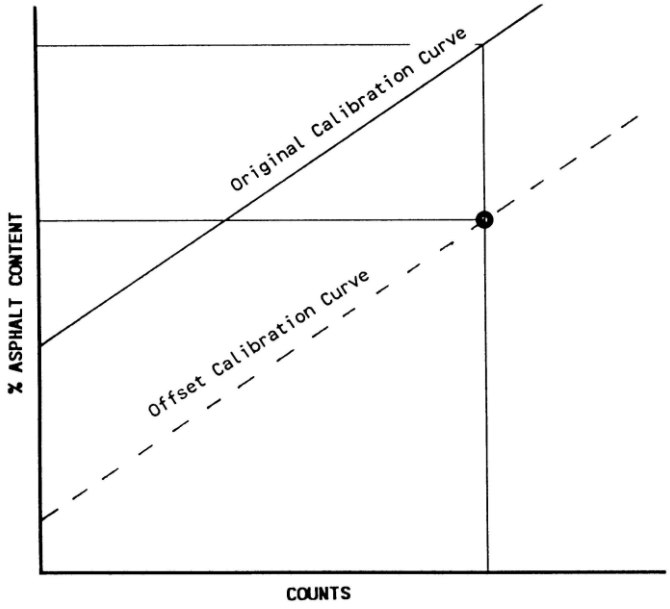


Figure 5. Example Relative Offset Graph

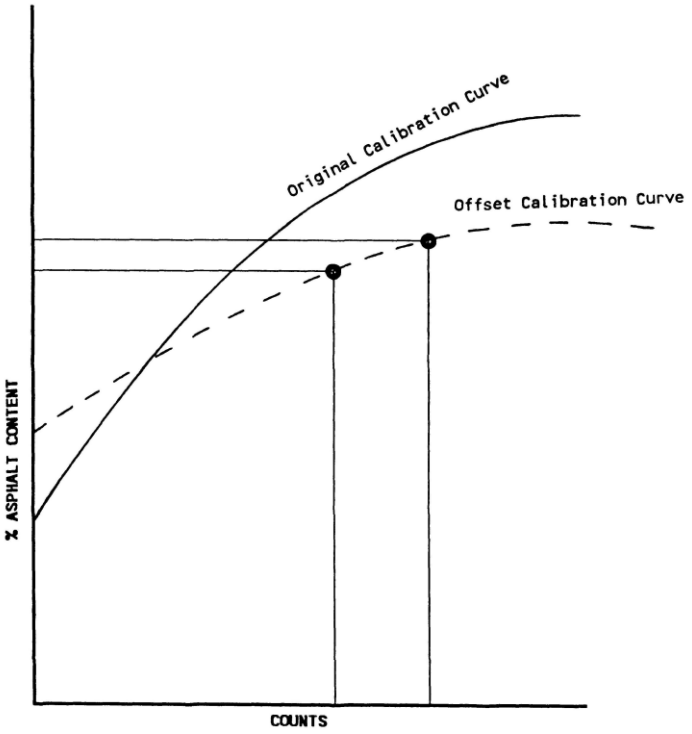


Figure 6. Example Slope/Intercept Offset Graph

Slope/Intercept Offset

If the asphalt sample gradation has changed, the original calibration can be adjusted with the slope/intercept offset (Figure 6). Two samples of known %AC must be prepared and tested in the gauge. The gauge calculates a new curve slope and intercept based on the offset samples. The original calibration will be adjusted by the calculated slope and intercept. This method enables the user to quickly adjust a calibration when more than three samples were used for the original calibration.

NOTE

An original 2-point calibration can also be performed using the two offset samples.

Press ⟨**SHIFT**⟩ and ⟨**8**⟩ for the *Offset* display:

```
   OFFSET CALIB
1- View Calibs.
2- Known Calib.
3- Exit
```

- Exit by pressing ⟨**3**⟩.
- If the calibration number is known, press ⟨**2**⟩. To perform the offset, select the type of offset and follow the gauge prompts.
- To scroll through the calibrations stored in memory, press ⟨**1**⟩. The display is:

```
   Calib: xxxxx
1- Scroll Up
2- Scroll Down
3- Select Calib.
```

To view the calibrations stored in memory, press ⟨**1**⟩ and ⟨**2**⟩. Select the calibration for offset by pressing ⟨**3**⟩. Perform the offset by selecting the method and following the gauge prompts.

Special

Refer to Chapter 7: for detailed information on the *Special* menu.

Project

Refer to pages 5-2 through 5-6 to create, view and/or erase a project previously stored in gauge memory.

Auto-Store / Auto-Print

The *Auto-Store* function allows automatic storage of gauge readings after completion of the count. A sample number will be assigned to the reading and will increment by one (up to 99) after each reading.

The *Auto-Print* function configures the gauge to automatically print the results of sample readings after each measurement.

NOTE

The Auto-Store and Auto-Print functions are independent of each other. One function can be on while the other is off.

Press ⟨**SHIFT**⟩ and ⟨**5**⟩ for the display:

- To change the status of the Auto-Store function, press ⟨**1**⟩.
- To change the status of the Auto-Print function, press ⟨**2**⟩.

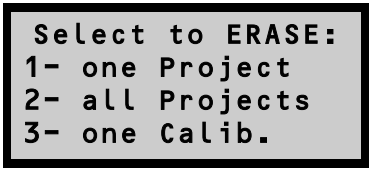
Erase

Erasing Projects

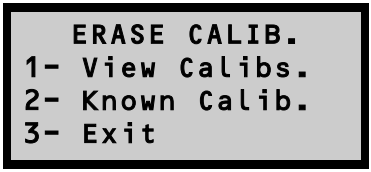
Refer to page 5-6 for details on erasing a project.

Erasing a Calibration

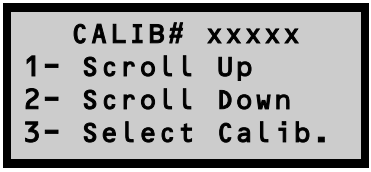
To remove a calibration, press ⟨**SHIFT**⟩ and ⟨**ERASE**⟩.



Press ⟨**3**⟩. The display is:



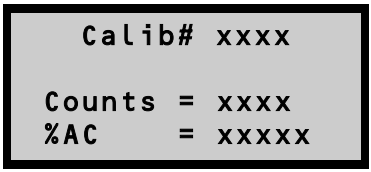
- If the calibration number is known, press ⟨**3**⟩. Enter the calibration number and press ⟨**SHIFT**⟩ and ⟨**YES**⟩ at the erase prompt. The gauge will return to the *Ready* screen.
- To scroll through the list of calibrations stored in the gauge, press ⟨**1**⟩.



View the calibrations by pressing ⟨**1**⟩ or ⟨**2**⟩. To select the calibration, press ⟨**3**⟩. To erase the calibration at the prompt, press ⟨**SHIFT**⟩ and ⟨**YES**⟩.

Recall

Use the *Recall* function to view the results of the last reading taken with the gauge. Press ⟨**SHIFT**⟩ and ⟨**1**⟩ for the *Recall* display:

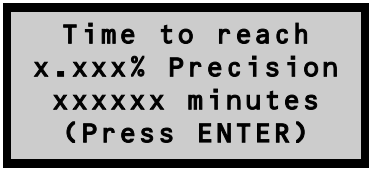


Target Precision

If you require a higher precision, the gauge may be programmed to automatically increase the count time to reach the desired precision. Using an ASTM precision equation, the count time will be adjusted. The maximum time allowed under this function is 60 minutes and is rounded to the nearest 15-second interval.

Press ⟨**SHIFT**⟩ and ⟨**2**⟩ for the *Precision* display:

Input the required precision and press ⟨**ENTER**⟩. The gauge will request the %AC. Input the %AC and press ⟨**ENTER**⟩. The gauge calculates the time required to obtain the requested precision.



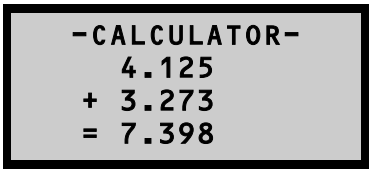
The gauge automatically enables the count time calculated to reach the target precision.

Calculator

The 3241 Series gauges are equipped with a four-function calculator. The function keys are located on the two left rows of the keypad. When the *Calculator* function is active these keys are enabled.

Press ⟨**SHIFT**⟩ and ⟨**3**⟩ to activate the *Calculator* function.

To perform the calculator operation, use the ⟨**+**⟩, ⟨**-**⟩, ⟨**x**⟩, ⟨**÷**⟩ keys located in the lower left corner of the keypad. The ⟨**=**⟩ key is located on the ⟨**START/ENTER**⟩ key.



Results may be stored in memory by pressing ⟨**MS**⟩ (Store). Retrieve results from memory by pressing ⟨**MR**⟩ (Print). Exit the calculator mode by pressing ⟨**EXIT**⟩ (Yes).

Calibration Sample Preparation

Refer to Chapter 4: for detailed information on preparing calibration samples.

The *Calibration Sample Prep* function allows the entry of the calibration values such as %AC, weight of mixing bowl, weight of aggregate, etc.

After prompting for the initial values, the gauge will automatically calculate the sample weight and prompt the user to add asphalt until the desired weight is reached. This information will be entered onto the Calibration Forms found in Appendix F.

Press ⟨**SHIFT**⟩ and ⟨**0**⟩ for the display:

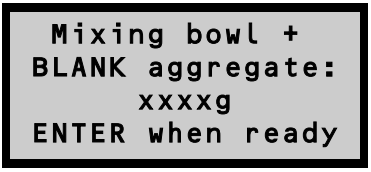
For the following example, Method 1 (% Asphalt by Aggregate Dry Weight) will be used.

Press ⟨**1**⟩. The gauge will request the % Asphalt Content.

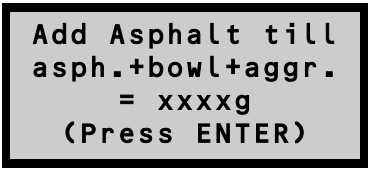
Input the %AC and press ⟨**ENTER**⟩.

Input the weight of the "scraped clean" mixing bowl (see Chapter 4). Press ⟨**ENTER**⟩.

Enter the weight of the aggregate that was used to prepare the blank sample. Press ⟨**ENTER**⟩. The gauge will calculate the combined weight.



The gauge instructs you to add asphalt to the aggregate until the displayed weight is reached.



Press ⟨**ENTER**⟩. Verify the weight and press ⟨**YES**⟩. The gauge will request the weight of the sample pan.

Input the weight of the empty sample pan. Press ⟨**ENTER**⟩.

The gauge will prompt you to add the sample mixture to the pan until the displayed weight is reached. Press ⟨**ENTER**⟩.

The sample is ready for calibration. Repeat the above procedure for each sample to be used.

NOTES

Chapter 7:
Special Functions

This chapter covers the following topics and tasks:

- ✓ Using the functions in the *Special* menu.

Stat Test

Erratic readings or readings that seem to fluctuate may indicate a problem with the gauge. In the event the readings are "suspect" the *Stat Test* may be executed to validate the normal operation of the gauge.

A *Stat Test* consists of twenty 1-minute counts. Although other count times are available (4, 8 and 16 minutes) they are not recommended, since the temperature correction process is not utilized during a stat test. Long count times (causing the stat test to run overnight) could result in the gauge undergoing temperature changes. It is very important that the ambient temperature remain the same during the stat test. The longer count times, however, can be used to check long-term gauge operation.

After the 20 counts, the gauge calculates the standard deviation. This standard deviation is compared to a theoretical standard deviation value. Ideally this ratio should be one. However, the 3241 prescale (or divide) for one minute counts is 4. This results in an ideal ratio of (0.5). The acceptable limits for the ratio are from (0.35) to (0.71). The gauge is considered to be unstable if the ratio is outside these limits. The table below gives the limits for other count times.

Ratio Table

Table 2. Range of Standard Deviation Ratios

Time	Limits
1	0.35 to 0.71
4	0.17 to 0.35
8	0.12 to 0.25
16	0.09 to 0.18

To execute a *Stat Test*, place the gauge in an area free of other gauges or radioactive sources. Press ⟨**SHIFT**⟩ and ⟨**9**⟩ to display the *Special* menu.

Press ⟨**1**⟩ for the display:

To accept the displayed count time, press ⟨**NO**⟩.

To change the count time, press ⟨**YES**⟩ and enter the desired count time. Select a count time of 1, 4, 8 or 16 minutes and then press ⟨**ENTER**⟩.

Remove any samples or sample pans from the gauge. Close the door and press ⟨**START**⟩.

After the 20 counts have been completed, the gauge will display the average counts and indicate if the test passed or failed. The individual count data may be viewed or printed at this time by pressing ⟨**YES**⟩ at the view data prompt. To return to the Ready mode without viewing the data, press ⟨**NO**⟩. View the data by pressing ⟨**YES**⟩ at the view data prompt.

Select the method of viewing the data. If a printout is desired refer to page 7-14 for the location of the serial port and baud rate selection. A sample printout is shown on page 7-5.

Drift Test

Assuming that the stat test has already been performed (and passed) but gauge readings seem to drift between tests, the Drift Test can be performed to check the long-term drift of the gauge.

The Drift Test consists of five counts performed approximately 3-4 hours after completion of a stat test.

NOTE

The count time is based on the last stat test. The drift test count time should be four times the stat test count time. The gauge should not be turned off between the stat test and drift test. The stat test must be current.

Press ⟨**SHIFT**⟩ and ⟨**9**⟩ to display the *Special* menu. To access the Drift Test feature, press ⟨**2**⟩ and ⟨**ENTER**⟩ for:

```
Will take five
xx min. counts.
Close door and
  Press START
```

Remove any samples or sample pans from the gauge and press ⟨**START**⟩.

After completion of the 5 counts, the gauge will display the average counts and indicate if the test passed or failed. The Pass/Fail criterion is ±1.0%.

```
Avg Cnts: xxxx
Drift: x.xx% P
Want to review
DRIFT test data?
```

The individual count data may be viewed or printed at this time. To return to the *Ready* mode without viewing the results, press ⟨**NO**⟩. View the data by pressing ⟨**YES**⟩ at the prompt. A sample print out is shown below.

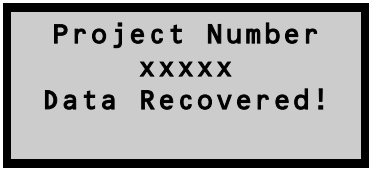
```
********************************
*  Statistical Stability Test  *
********************************
Count Time = 1 min.
     9:23 AM    4/12/93
Serial #:   960
   #   Counts  |     #   Counts
   1    2486   |     2    2465
   3    2455   |     4    2476
   5    2500   |     6    2481
   7    2454   |     8    2475
   9    2427   |    10    2471
  11    2443   |    12    2479
  13    2474   |    14    2489
  15    2443   |    16    2428
  17    2453   |    18    2491
  19    2469   |    20    2457

--------------------------------
Average counts:2466
Ratio:   0.41 PASS
********************************
```

Figure 7. Sample Stat Test Printout

Recover Erase

In the event that project data is inadvertently erased, the *Recover Erase* function may recover the lost information. There is no guarantee that this function will successfully recover the lost data. If data has been stored after an accidental erasure, a successful recovery is impossible.

Press ⟨**SHIFT**⟩ and ⟨**9**⟩ to display the *Special* menu. Access the *Recover Erase* feature by pressing ⟨**9**⟩. If the recovery is successful the display will be:



Time/Date

Refer to page 3-5 for information on changing the time or date.

Calibration Transfer

During paving operations several asphalt content gauges may be used for quality control of the asphalt mix . These gauges usually include one central "master" gauge and numerous "field" gauges. When more than one gauge is used to determine the asphalt content of a single asphalt mix, each gauge must be separately calibrated for that mix. This process can involve preparing calibration samples and manually calibrating each gauge. Performing individual gauge calibrations is labor intensive, time consuming and may involve transporting the gauges between laboratories. Additionally, the gauges will be out of use during the time required for calibration.

Calibration Transfer overcomes many of the problems associated with using multiple gauges for one particular mix design. This procedure allows the transfer of a central "master" gauge calibration to multiple "field" gauges, without the need for individual gauge calibrations. Calibration transfer reduces gauge downtime, reduces labor and helps ensure more uniform asphalt content measurements among all gauges. Calibration transfer also reduces the chance of error produced by the sample preparation techniques preferred by different operators.

The "master" gauge resides in the central laboratory and is used to perform the different mix calibrations. The "field" gauge resides in the field laboratory and receives the calibration constants from the "master" gauge for the different mix designs. The "field" gauge does not perform any calibrations after the cross calibration procedure.

The first step of the calibration transfer process is the cross calibration of the "master" gauge to all of the "field" gauges. This procedure need only be performed once for each "field" gauge. A minimum of five calibration samples will be used to obtain an initial relational curve (or correlation) between the "master" and "field" gauges. These samples must include one sample with at least 0.5% asphalt above the normal mix range and one sample with at least 0.5% asphalt below the normal mix range. The five calibration samples must be prepared and measured on the same day.

If preparing sealed (special) calibration samples (see Appendix E) that span the mix range, these samples may be used to determine the relational curve. For each "field" system,

measurements of the special samples should be taken with both the “master” and “field” gauges.

After the cross calibration is completed, calibrations performed on the “master” gauge can be transferred to the “field” gauges without additional “field” gauge calibrations. This transfer is performed by entering the “master” gauge background count and calibration constants into the “field” gauges. Based on the cross calibration data, the constants will be adjusted to reflect the differences between the “master” gauge and each “field” gauge.

Cross Calibration

If a cross calibration has already been performed go to page 7-14 for information on transferring a calibration.

The following steps must be performed prior to transferring a calibration from a “master” gauge to a “field” gauge.

Prepare a minimum of five cross calibration samples. Refer to Chapter 4 for detailed instructions on preparing asphalt samples for calibration. These samples must be prepared with one sample containing at least 0.5% asphalt above the range of all the mixes used and one sample with 0.5% asphalt below the normal range.

Set the count time to 16 minutes.

On the “Master” Gauge

1. Press ⟨**CALIB**⟩.
2. Take a new background count and record the value.
3. Perform a calibration with the five samples.
4. Record the counts obtained on each sample.

On the "Field" Gauge

Perform a cross calibration on the "field" gauge. This procedure, discussed in detail on the following pages, only needs to be performed one time to set up the relationship between the "master" and "field" gauges.

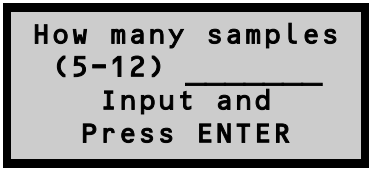
The following is an overview of the procedure:

1. Input the number of samples.
2. Perform a background count.
3. Measure the samples/
4. Input "master" gauge background count.
5. Input the five sample counts taken with the "master" gauge.
6. Enter the transfer number.

This procedure should be repeated for each "field" gauge.

Press ⟨**SHIFT**⟩ and ⟨**9**⟩ to display the *Special* menu. To access the *Calibration Transfer* feature, press ⟨**9**⟩. The display will be:

Press ⟨**1**⟩ for Cross Calibration mode.



Input the number of asphalt samples (the same number of samples used with the "master" gauge).

You have the option of manually entering the count data using the keypad or automatically taking the measurements using the gauge.

- To manually enter sample data, press ⟨**1**⟩. The samples must have been previously measured in either the Calibration or Cross Calibration mode.
- For gauge derived cross calibration data collection, press ⟨**2**⟩.

This procedure assumes the gauge derived method.

1. The gauge will request a background count. If the background count is not current or the gauge has been moved, press ⟨**YES**⟩. Empty the sample chamber and press ⟨**START**⟩.
2. If the background count is acceptable, press ⟨**YES**⟩.
3. Input the sample %AC. The display requests the first sample.

4. To measure the first sample, press ⟨**START**⟩. After the measurement is complete, the gauge requests that the remaining samples be measured.

5. When all the samples have been measured, the gauge requests the background count from the "master" gauge (this value was recorded earlier, see the previous page).

6. Input the background count from the "master"" gauge.

7. The gauge requests the sample counts obtained with the "master" gauge. Input the "master" gauge sample counts. The counts must be entered in the same order as the "field" counts that were taken above!

8. After entering the "master" gauge sample counts the "field" gauge will calculate a relational calibration curve, used later for transferring calibrations from the "master" to the "field" gauge.

9. When the calculations are complete, the data may be viewed or printed.

- To return to with the cross calibration process without reviewing the data, press ⟨**NO**⟩.
- To view the data on the display, press ⟨**2**⟩. After reviewing the data, continue by pressing ⟨**1**⟩.

- To print the data, press ⟨**3**⟩. Continue by pressing ⟨**1**⟩. The gauge will request a transfer number.

Input the transfer number (up to 8 numbers). This number can be composed of the gauge serial numbers. For example, if the "master" gauge serial number is 650 and the "field" gauge serial number is 658 the transfer number can be 650.658. After entering the transfer number, press ⟨**ENTER**⟩.

The cross calibration is complete and will be stored.

At this time the "master" gauge can be used to perform calibrations for different mix designs. Calibrations may now be transferred to the "field" gauges without additional "field" gauge calibrations.

Transfer

Once a cross calibration has been performed and stored, "master" gauge calibrations may be transferred to the "field" gauge without the need for a complete "field" gauge calibration.

On the "Master" Gauge

Prepare asphalt samples for the particular mix being used and perform a calibration (see Chapter 4) on the "master" gauge. After completion of the calibration, record the sample weight, the "master" gauge background count, and calibration constants A1, A2 and A3.

On the "Field" Gauge

Press ⟨**SHIFT**⟩ and ⟨**9**⟩ to display the Special menu. To access the *Calibration Transfer* feature, press ⟨**9**⟩. The display will be:

Press ⟨**2**⟩ for the display:

The transfer number is established after the cross calibration of the "master" and "field" gauges (refer to page 7-12).

- If the transfer number shown is correct press ⟨**1**⟩.
- To scroll through the list stored numbers, press ⟨**2**⟩.
- The transfer number displayed on the gauge may be erased by pressing ⟨**3**⟩.

After selecting the correct transfer number, input the calibration information from the "master" gauge into the "field" gauge. Enter the sample weight, the background count, and calibration constants A1, A2, and A3.

Store this calibration. When a calibration is stored under the Calibration Transfer mode, /x is placed after the calibration number.

The "field" gauge is now ready to measure the unknown samples of asphalt.

Baud Rate

Configuring the *Baud Rate* allows the gauge to communicate with an RS-232 serial device such as a printer or computer.

The baud rate—the communication speed—should be set to match the peripheral device. Refer to the device's instruction manual for the proper settings.

Press ⟨**SHIFT**⟩ and ⟨**9**⟩ to display the *Special* menu. To access the *Baud Rate* function, press ⟨**6**⟩ for the display:

```
Baud Rate: xxxx

Want to change?
```

- Accept the displayed baud rate by pressing ⟨**NO**⟩.
- If the baud rate is incorrect, press ⟨**YES**⟩.

```
Baud Rate: xxxx
Select: 1- 110
2- 300  3- 600
4- 1200 5- 2400
```

Input the baud rate that matches the printer or computer.

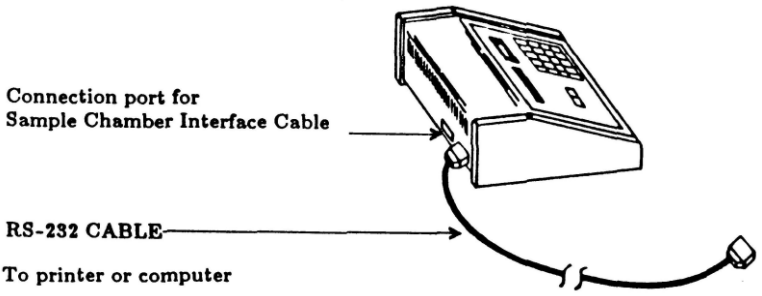


Figure 8. Serial Device Connection

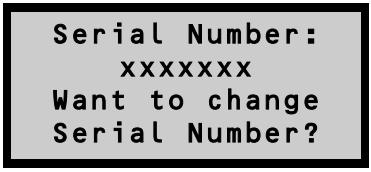
Customer Name

Refer to page 3-6 for information on this function.

Serial Number

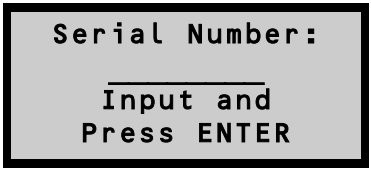
The *Serial Number* function allows you to re-enter the gauge serial number.

Press ⟨**SHIFT**⟩ and ⟨**9**⟩ to display the *Special* menu. To access the *Serial Number* function, press ⟨**8**⟩ for the display:



To change the gauge serial number, press ⟨**YES**⟩.

This feature requires an access code to prevent tampering by unauthorized personnel. Retrieve the access code from your Troxler representative and input the access code. Press ⟨**ENTER**⟩.



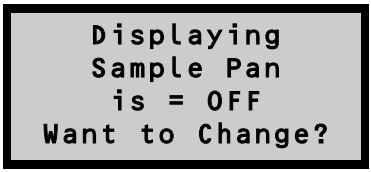
Input the new serial number and press ⟨**ENTER**⟩.

Pan Weight Display

The *Pan Weight Display* function allows you to configure the gauge to display the weight of the sample pan before taking a sample measurement.

With the *Pan Weight Display* enabled, the gauge will request the weight of the empty pan. After input of the weight, the gauge will instruct you to fill the pan with asphalt until the proper weight is reached.

Press ⟨**SHIFT**⟩ and ⟨**9**⟩ to display the *Special* menu. To access the *Pan Weight Display* feature, press ⟨**9**⟩ for the display:



To enable the pan weight display, press ⟨**YES**⟩.

Appendix A: Radiological Information

This appendix is required reading for anyone who will operate a Model 3241 Series gauge. Information covering radiation theory is contained in this appendix along with a brief explanation of radiation statistics and radiation terminology.

This chapter covers the following topics and tasks:

- ✓ Radiation theory, terminology, and safety
- ✓ Types of radiation
- ✓ How to limit your exposure
- ✓ Radiation profiles

Radiation Theory

A more detailed discussion of radiological theory can be found in the *Troxler Nuclear Gauge Safety Training Program* manual, provided you have taken the Troxler Nuclear Gauge Safety training course. Visit our website at www.troxlerlabs.com for more information.

Atomic Structure

All materials consist of chemical elements that cannot decompose by ordinary chemical methods. Some examples are:

(H) Hydrogen	(C) Carbon	(O) Oxygen
(U) Uranium	(Cf) Californium	(Co) Cobalt

Each element contains an atom with a unique structure. The atom consists of smaller particles such as protons, neutrons and electrons. The protons and neutrons are grouped together in the nucleus. The electrons orbit the nucleus (Figure 9). An atom is normally electrically neutral because the positive protons cancel out the negative electrons.

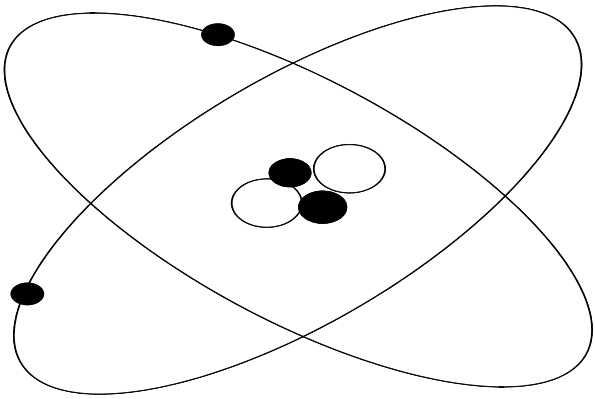


Figure 9. Diagram of an Atom

Protons carry a positive charge and are described as having a mass of one. Neutrons have a neutral charge and have a mass of one. Electrons carry a negative charge and essentially have no mass.

Mass (Atomic Weight Scale)	Charge
Protons 1.0073	+1
Neutrons 1.0087	0
Electrons 0.0006	-1

Because protons and neutrons are clustered together in the nucleus, the mass of an atom is concentrated in the nucleus. The atom below has two protons and two neutrons; therefore, it is a helium atom. The atomic weight of an atom is the sum of the protons and neutrons.

Radiation Theory

Radioactivity is the spontaneous breakdown of unstable nuclei (radioisotopes) with the resulting emission of radiation. The basic unit of radiation used in the U.S. is the curie (Ci) and is defined as 3.7×10^{10} disintegrations of nuclei per second. In the "Special Form," encapsulated sealed source used in the 3241, the unit of measure is the millicurie (1/1,000 of a curie). The SI unit of radiation is the Becquerel and is equal to one disintegration per second. Therefore, one curie equals 3.7×10^{10} Becquerels.

The strength of radioactive material is measured by its activity, or rate of decay. This activity decreases with time. The length of time it takes a given amount of radioactive material to decay to half of its original strength is referred to as the "half-life." The half-life of an Americium-241 source is approximately 432 years.

Radiation Terminology

Various standards for the measurement of radiation exist, but only two concern the Troxler instrument user. These units are the curie and the **r**oentgen **e**quivalent **m**an (rem). The curie, defined as the quantity of radioactive material giving 3.7×10^{10} disintegrations per second, is equal to the number of disintegrations/second of one gram of radium-226. Note that the source used in the 3241 is small, with quantities expressed in millicurie (mCi) or Gigabecquerels (GBq).

The **rad** or "**r**adiation **a**bsorbed **d**ose," is the unit of absorbed dose that is equal to 0.01 Joules/kg in any medium. In order to take into consideration the effect of various types of radiation on biological tissue, the rem, or more appropriate for Troxler users - the millirem - is used to measure radiation dosage. The unit rem is derived from scaling the radiation absorbed dose (rad) by a quality factor (QF). One **rad** is equal to the exposure of one **rem** of photon radiation.

For example, the average neutron energy of an Americium-241:Beryllium source is approximately 4.5 MeV. The quality factor (QF) for this radiation is approximately 10. The absorbed dose of 1 rad of neutron radiation produces a dose equivalent of (absorbed dose x QF) 10 rem.

Occupational exposure limits are set by government agencies. The current limit in the United States and many other countries is 5,000 millirem per year. Under average conditions, a full time employee working with the 3241 will receive less than 200 millirem per year.

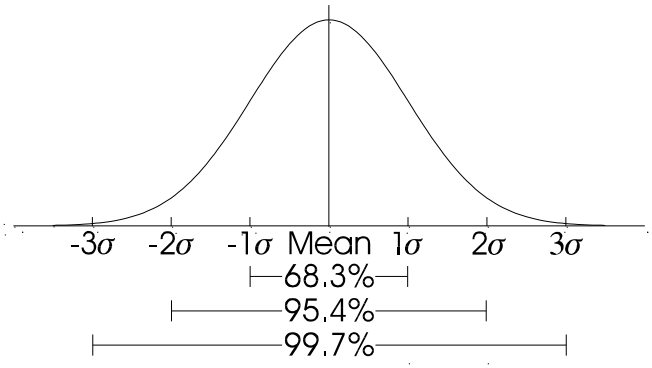
Anyone working with or near radioactive materials is subject to the limits on occupational exposure mentioned earlier and must complete a radiation safety training course to be designated an authorized user. As an authorized user, an individual so designated must work in a "controlled" environment to the extent that their exposure to radiation must be monitored. Several means of personnel monitoring or *dosimetry* exist; the most common methods are film badges and TLD badges, available from Troxler.

Radiation Statistics

Radioactive emission is a random process. The number of emissions in a given time period is not constant but varies statistically about an average value. The variation about the true mean value is a Poisson distribution. In this distribution, the standard deviation (σ) about the mean (n) is defined as:

$$\sigma = \sqrt{n}.$$

When the mean is greater than 100, the Poisson distribution can be closely approximated by the normal distribution (Figure 12). The normal distribution predicts the probability that any given count rate will fall within a selected region about the mean.



Normal Distribution

Figure 10. Variation of Radioactive Emission

Using the mean of a larger number of counts to approximate the true mean, the distribution shows that 68.3% of the time the count rate obtained will be within ±1 standard deviation of the mean. Figure 10 shows the chance of counts falling within three standard deviations. A statistical stability test may be performed to compare the experimental standard deviation to the theoretical standard deviation (see page 7-2).

Radiation Safety

This section provides a brief discussion of general radiation safety. The exposure profiles for the Model 3241 gauge are also included, along with a discussion of the source encapsulation.

Types of Radiation

The radioactive source in the Model 3241 Series produce three types of radiation:

- Alpha Particles
- Photons
- Neutrons

Alpha particles are stopped by the source capsule. Only the photon and neutron radiation contribute to the occupational radiation exposure.

Photon radiation is electromagnetic radiation, as are x-rays, radio waves, and visible light. Visible light and photons have no mass, a zero electrical charge and travel at the speed of light. Photons are energetic and penetrating. Dense materials provide the best shielding against photon radiation.

Neutron radiation allows measurement of the asphalt content in a material because the neutrons are slowed by collisions with materials containing hydrogen atoms. Neutrons have a neutral charge and are very penetrating.

Limiting Exposure

Current regulations for both NRC and Agreement States have established a whole body occupational exposure limit of 5,000 millirem per year. Under normal conditions, a full-time gauge operator will receive less than 200 millirem per year.

Taking advantage of all available means to limit radiation exposure is always recommended. The three methods of limiting exposure are:

- Time
- Distance
- Shielding

These methods are a part of an "**ALARA**" (**A**s **L**ow **a**s **R**easonably **A**chievable) program.

TIME

The simplest way to reduce exposure is to keep the time spent around a radioactive source to a minimum. If time is cut in half, so is the exposure, with all other factors remaining constant.

DISTANCE

Distance is another effective means to reduce radiation exposure. A formula known as the "inverse square law" relates the radiation exposure rate to distance (Figure 13). Doubling the distance from a radiation source reduces the exposure to one-fourth its original value. If the distance is tripled, the exposure is reduced by a factor of nine, etc.

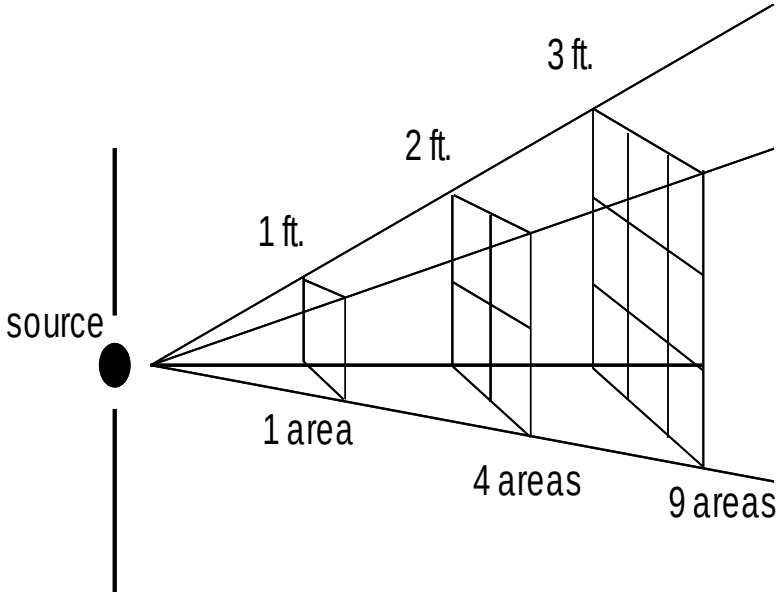
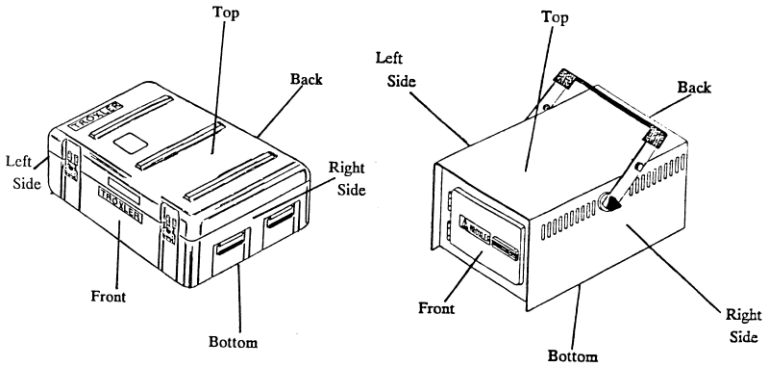


Figure 11. Effect of Distance on Exposure

SHIELDING

Shielding is any material used to reduce the radiation reaching the user from a radioactive source. While some types of radiation such as alpha particles may be stopped by a single sheet of paper, other particles such as neutrons and photons require much more shielding. Materials containing large amounts of hydrogen, such as polyethylene, are used to shield neutrons. Dense materials, such as lead, are used to shield photons. The Model 3241 Series gauges have shielding built into the system which reduces the exposure.

3241-C (100 mCi) Radiation Profile



RADIATION PROFILE FOR 3241 GAUGE (100 mCi)

LOCATION	SURFACE			10 cm.			30 cm.			1 Meter		
	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total
FRONT	1.5	3.5	5.0				0.2	0.8	1.0	*	0.1	0.1
BACK	0.5	1.9	2.4				0.1	0.6	0.7	*	*	*
LF. SIDE	0.7	4.0	4.7				*	1.1	1.1	*	*	*
RT. SIDE	1.5	4.0	5.5				0.2	1.4	1.6	*	0.1	0.1
TOP	3.0	8.0	11.0				0.2	1.4	1.6	*	0.1	0.1
BOTTOM	2.0	4.0	6.0				0.15	1.4	1.55	*	0.1	0.1

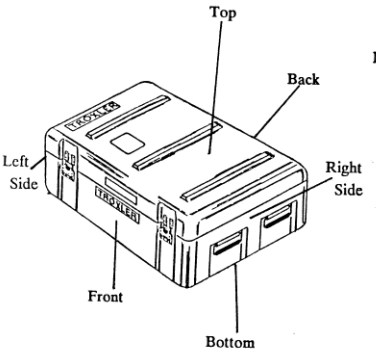
RADIATION PROFILE FOR 3241 IN PLASTIC CASE (100 mCi)

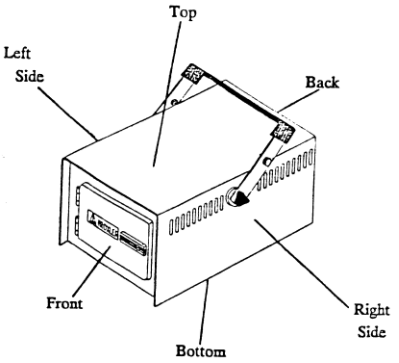
LOCATION	SURFACE			10 cm.			30 cm.			1 Meter		
	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total
FRONT	0.3	1.4	1.7				0.1	0.4	0.5	*	0.1	0.1
BACK	0.3	1.2	1.5				0.1	0.4	0.5	*	0.1	0.1
LF. SIDE	*	0.3	0.3				*	0.1	0.1	*	*	*
RT. SIDE	0.3	1.2	1.5				*	0.4	0.4	*	0.1	0.1
TOP	0.9	1.6	2.5				0.1	0.6	0.7	*	0.1	0.1
BOTTOM	0.2	1.1	1.3				*	0.3	0.3	*	0.1	0.1

Figure 12. 3241 (100 mCi) Radiation Profile

1. All readings in mrem/h.
2. * indicates reading less than or equal to 0.1 mrem/h.
3. Measurements made with Nuclear Research Corp., Model NP-2 Survey Meter, calibrated March 1989.
4. Dose Rates for 100 mCi Americium-241:Beryllium source.

3241-C (300 mCi) Radiation Profile





RADIATION PROFILE FOR 3241 GAUGE (300 mCi)

LOCATION	SURFACE			10 cm.			30 cm.			1 Meter		
	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total
FRONT	3.0	9.0	12.0				0.4	3.0	3.4	*	0.4	0.4
BACK	1.5	6.0	7.5				0.3	1.8	2.1	*	0.4	0.4
LF. SIDE	3.0	10.0	13.0				0.3	3.0	3.3	*	0.4	0.4
RT. SIDE	3.0	9.0	12.0				0.2	3.0	3.3	*	0.5	0.5
TOP	11.0	30.0	41.0				0.4	5.0	5.4	*	0.5	0.5
BOTTOM	4.0	10.0	14.0				0.3	4.0	4.3	*	0.5	0.5

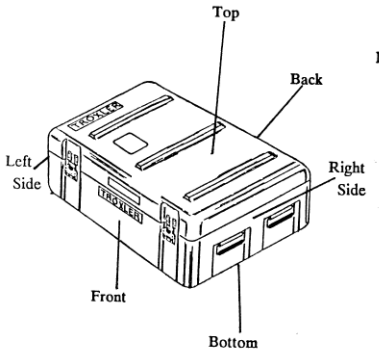
RADIATION PROFILE FOR 3241 IN PLASTIC TRANSPORT CASE (300 mCi)

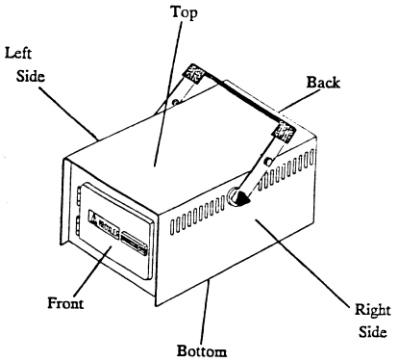
LOCATION	SURFACE			10 cm.			30 cm.			1 Meter		
	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total
FRONT	1.2	4.0	5.2				0.4	1.1	1.5	*	0.4	0.4
BACK	0.9	6.0	6.9				0.2	1.2	1.4	*	0.3	0.3
LF. SIDE	0.1	1.0	1.1				*	0.5	0.5	*	0.2	0.2
RT. SIDE	0.6	5.0	5.6				0.2	1.2	1.4	*	0.3	0.3
TOP	2.0	6.0	8.0				0.3	1.8	2.1	0.1	0.4	0.5
BOTTOM	0.6	4.0	4.6				0.2	1.5	1.7	*	0.4	0.4

Figure 13. 3241 (300 mCi) Radiation Profile

1. All readings in mrem/h.
2.* indicates reading less than or equal to 0.1 mrem/h.
3. Measurements made with Nuclear Research Corp., Model NP-2 Survey Meter, calibrated March 1989.
4. Dose Rates for 300 mCi Americium-241:Beryllium source.

3241-D (80 mCi) Radiation Profile





RADIATION PROFILE FOR 3241-D GAUGE (80 mCi)

LOCATION	SURFACE			10 cm.			30 cm.			1 Meter		
	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total
FRONT	0.2	2.6	2.8				0.1	0.8	0.9	*	0.2	0.2
BACK	0.2	1.2	1.4				*	0.8	0.8	*	0.2	0.2
LF. SIDE	0.3	1.8	2.1				0.1	0.8	0.9	*	0.2	0.2
RT. SIDE	0.3	2.6	2.9				0.1	0.6	0.7	*	0.2	0.2
TOP	1.1	3.8	4.9				0.1	1.8	1.9	*	0.2	0.2
BOTTOM	0.2	1.4	1.6				0.1	0.6	0.7	*	0.2	0.2

RADIATION PROFILE FOR 3241-D IN PLASTIC TRANSPORT CASE (80 mCi)

LOCATION	SURFACE			10 cm.			30 cm.			1 Meter		
	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total
FRONT	0.1	1.2	1.3				*	0.8	0.8	*	0.1	0.1
BACK	0.1	0.8	0.9				0.1	0.6	0.7	*	0.1	0.1
LF. SIDE	*	0.6	0.6				*	0.2	0.2	*	0.1	0.1
RT. SIDE	0.1	1.0	1.1				*	0.4	0.4	*	0.1	0.1
TOP	0.4	1.6	2				0.1	1.0	1.1	*	0.1	0.1
BOTTOM	0.1	1.0	1.1				*	0.8	0.8	*	0.1	0.1

Figure 14. 3241-D (80 mCi) Radiation Profile

1. All readings in mrem/h.
2.* indicates reading less than or equal to 0.1 mrem/h.
3. Measurements made with Bicron Micro Rem (Low Energy), calibrated January 2011, and Ludlum Model 12-4, calibrated September 2010.
4. Dose Rates for 80 mCi Americium-241:Beryllium source.

Source Encapsulation

The sources in the Model 3241 Series gauges meet regulatory requirements of U.S. and international authorities as "SPECIAL FORM," or encapsulated, sealed source material. The "sealed" sources are encapsulated to prevent leakage of the radioactive material and meet radiation safety requirements.

The neutron source (Americium-241:Beryllium) is compressed and welded inside stainless steel capsules.

The only radiological health concerns to Troxler instrument users are the photon and neutron emissions for asphalt content measurement. Proper use of this instrument (following the instructions in this manual) and the shielding design of the instrument will keep the exposure levels at a minimum under normal conditions. It is recommended that you monitor your exposure with personnel dosimetry when operating the 3241 gauge.

NOTES

Appendix B: Specifications

This chapter covers the following topics and tasks:

- ✓ Measurement Specifications
- ✓ Radiological Specifications
- ✓ Electrical Specifications
- ✓ Mechanical specifications

Measurement Specifications

Gauge Precision at 6% ASPHALT

(one standard deviation)

80 mCi Americium-241:Beryllium

1 Min.	4 Min.	8 Min.	16 Min.
±0.100%	±0.050%	±0.035%	±0.025%

100 mCi Americium-241:Beryllium

1 Min.	4 Min.	8 Min.	16 Min.
±0.084%	±0.042%	±0.029%	±0.021%

300 mCi Americium-241:Beryllium

1 Min.	4 Min.	8 Min.	16 Min.
±0.070%	±0.035%	±0.025%	±0.018%

.

NOTES

- Range of control mix = 0 to 14% asphalt
- Gauge precision is calculated using the ASTM precision equation:

```
Precision~=~ {SQRT {Count}} OVER slope
```

Where:

Slope = slope of the calibration curve at a given %AC

Count = gauge count at a given %AC

Radiological Specifications

Neutron Source	2.96 ±0.42 GBq (80 ±11.3 mCi) Am-241:Be, *or* 3.7 ±0.37 GBq (100 ±10 mCi) Am-241:Be, *or* 11.1 ±1.11 GBq (300 ±30 mCi) Am-241:Be
Source Type	Sealed Source - Special Form
Source Housing	Stainless Steel, Double Encapsulated
Shielding	Polyethylene and Lead
Surface Dose Rate	See Radiation Profiles (pages A-10 through A-12)
Shipping Case	DOT 7A, Type A

Electrical Specifications

Time Accuracy and Stability	±0.005% ±0.0002% / °C
Power Supply Stability	±0.01% / °C
Charge Source	110/220 VAC, 50-60 Hz / 12 VDC
Liquid Crystal Display	4 line x 16 character
Keypad	22 key sealed membrane
Power Consumption	0.2 watts average
RAM	8 kbytes non-volatile
ROM	64 kbytes
Max Test Data Storage	99 files
Max Calibration Storage	64 files
Serial Data Format:	8 Data Bits, 2 Stop Bits, No Parity

Gauge to PC Compatible Computer Cable (PN 104334.1000):

Gnd (pin 1)	-----	Gnd (pin 1)
Tx (pin 2)	-----	Rx (pin 3)
Rx (pin 3)	-----	Tx (pin 2)
DSR (pin 6)	-----	DTR (pin 20)
DTR (pin 20)	-----	DSR (pin 6)
Gnd (pin 7)	-----	Gnd (pin 7)

Gauge to WEIGH-TRONIX® Printer Cable (PN 104324.1000):

Gnd (pin 1)	-----	Gnd (pin 1)
Tx (pin 2)	-----	Rx (pin 2)
CTS (pin 5)	-----	DSR (pin 6)
DSR (pin 6)	-----	CTS (pin 5)
Gnd (pin 7)	-----	Gnd (pin 7)

Mechanical Specifications

Enclosure	Aluminum and Stainless Steel
Sample Chamber Size	375 x 279 x 267 mm (14.75 x 11.0 x 10.5 in.)
Console Size	219 x 279 x 90 mm (8.6 x 11.0 x 3.5 in)
Weight	15.9 kg (35 lbs)
Shipping Weight	31.9 kg (70 lbs)
Operating Temperature (ambient)	-10 to 70 °C (14 to 158 °F)
Sample Temperature (maximum)	177 °C (350 °F)
Chamber Temperature (maximum)	77 °C (170 °F)
Vibration Test	2.54 mm (0.1 in.) at 12.5 Hz
Drop Test	300 mm onto 25 mm steel ball

This gauge contains sensitive electronic components and radioactive materials. This gauge must not be subjected to stress, abuse or operation other than in accordance with the standard operating procedures listed in this manual.

.

NOTES

Appendix C: Maintenance & Troubleshooting

This chapter covers the following topics and tasks:

- ✓ Troubleshooting
- ✓ Leak testing
- ✓ Replacement parts
- ✓ Returning the gauge for service

Troubleshooting

If any of the listed problems should arise, follow the procedure under the difficulty heading before contacting service personnel.

Gauge Fails Self-Test (He^3 Tube Error)

- Make sure the sample chamber is empty! Test will fail if a sample is in the chamber.
- Check He^3 tube connections at the baseboard (open rear panel on sample chamber).
- Exchange high voltage module with good module. The high voltage module is located on the baseboard.
- The electrical connection between the sample chamber and the control unit may not be good. Check the cable with an ohm meter.
- Perform gauge initialization.

Gauge Does Not Turn "On"

- With an ohm meter, check the fuse inside the control unit.
- Ensure AC adapter is supplying at least 12 VDC.
- Check wall outlet for 120 VAC.

Control Unit Displays "Gauge Too Hot" Error

- Check for overheated condition.
- Check heat sensor connections to baseboard.
- Replace heat sensors. One is located above and one below the sample chamber.

Control Unit Displays “Garbage” or Blank Lines

- CPU board to display cable may not be making good connection. Open the control unit and reseat the cable.
- Check all chips and I.C.'s for proper seating in sockets.
- If the smartwatch is defective, replace (part no. 104620, chip designation U-12). Call customer service for assistance.

Gauge Readings are not Accurate

- Check the background count. If the counts have changed by more than 2%, check for other radiation sources or hydrogen bearing materials in the area.
- Perform (20 - 1 minute) stability (stat) test. If first test fails, repeat. Record all results.
- Perform drift test. If the gauge is unstable or drifts, replace the High Voltage Module with a good module.
- Enable the factory calibration in the “problem” gauge and in a good gauge (if available). Measure a sample in both gauges and compare the result. The % Asphalt Content (AC) readings should be similar if the gauge is functioning properly.
- If only one gauge is available, place a “sealed” sample in the gauge. Recall the calibration curve that corresponds to the sample. Measure the “sealed” sample and compare the results to the original calibration data. Ensure that the background count is current. Refer to Appendix E for preparing a “sealed” calibration sample.
- If software has recently been updated or the gauge has been re-initialized, the reference voltage may need to be re-entered. Refer to the tag on the back of the gauge. Re-enter the voltage even if the correct voltage is displayed.

Gauge Appears to be Unstable

- Perform a stability (stat) test (20 - 1 minute counts). Perform a drift test (5 - 4 minute counts).
- If the above tests pass, recheck the calibration parameters and samples.

Gauge will not Communicate with Printer

- Check the cable for continuity.
- Check baud rates.
- Check cable pin-out (see page B-4).
- Make sure all other parameters match:
    - Data bits = 8
    - Stop bits = 2
    - Parity = none
    - Protocol = DSR/DTR

Software is not Functioning Properly

- Re-initialize the gauge.
- Contact customer service.

Leak Testing

To ensure the integrity of the radioactive source encapsulation, the 3241 gauges must be leak tested at intervals not exceeding six months unless otherwise indicated by your license. Some countries may require leak testing be performed only by authorized, licensed institutions. Troxler is approved to perform leak test services. Call **1-877-TROXLER** to order a leak test kit.

Each individual who leak tests the gauge is required to wear appropriate personnel monitoring during this duty.

Using the Troxler leak test kit and accompanying instructions perform the following procedure:

1. Write the date and gauge model and serial numbers on the form and on the wipe folder.
2. Open the sample chamber door and locate the round indentation on the inside top plate (centered between the two screw heads).
3. Using the wipe disk, wipe the area around the indentation.
4. Pack the disk, as instructed, in the envelope and mail to Troxler for analysis.
5. Secure the gauge properly.

Battery Charging

If your gauge is equipped with rechargeable batteries, the batteries should be charged as often as possible. Unlike other gauges that use Ni-Cad batteries, the 3241 batteries require continuous charging.

NOTE

Do not use alkaline batteries in the Model 3241!

Replacement Parts

Part #	Description
104410	AC Charger 12VDC 500MA
104155	AC Charger 13.6VDC 500MA (int'l)
104156	DC Charger (cig. lighter adapter)
104639	Power Module Assembly.
104584	3241 Cable Assembly Scaler/Base
104544	3241 Overlay (keypad)
012158	Latch Corbin (door lock)
104523	Latch Strike
012104	Foam Grip 3241 (for handle)
100101.0100	Knob with Shaft (for handle)
105327	He^3 Tube Assembly
104095	900 VDC Helium Detector
105950	Assembly, CPU Board (3241X)
106797	3241 Baseboard Assembly
105244	High Voltage PCB Assembly
016210.0025	Fuse, 3AG, ¼ Amp, Normal Blow
104620	Smartwatch w/ 8Kx8RAM
104588	Temperature Sensor Assembly
104575	3241 Operator's Manual
012177	Lock with 2 Keys (H-1209)

Accessories

Part #	Description
105446	Cover, Asphalt Pan
012402	Pan Sample for Asphalt Content
021140	Radiation sign kit
102868	3880 Leak test kit w/ 4 Packets
102876.0005	Leak Test Packet (4 replacement)
102873	1 oz solution detergent
104340	Printer (Weigh-tronix)
104324.1000	Cable, (Weigh-tronix) Printer-to-Gauge (M/M)
104334.1000	Cable, PC-to-Gauge (FEM/MAL)
109661	Survey Meter

Returning the Gauge for Service

All shipments to the factory from within the United States must be accompanied by an RGA (Returned Goods Authorization) number, and a description of the instrument and its problem. This information is used by Troxler shipping and service personnel to expedite the repair work.

To obtain an RGA number, please call or fax the factory or branch office with your request. Please have the following information available when contacting Troxler for an RGA number:

- Gauge model and serial number.
- Part number/serial number (if applicable).
- Is the gauge still under warranty?
- Problem or difficulty you are having with the instrument.
- Shipment method to Troxler and for return shipment.
- Shipping and billing address (not P.O. Box) – street address and ZIP code.
- Telephone number and contact (for questions from Troxler).
- Will estimate be required before performing any work on the gauge?
- Payment method: credit card, account number, or purchase order number. All U.S. government agencies (city, county, state and federal) must send purchase order numbers.

To prevent order duplication, if an order has been placed by telephone, please write "Confirming Order" on any follow-up written requests.

Returning a Model 3241 Series gauges will require special handling and shipping procedures found in Appendix D. Shipping forms are available at www.troxlerlabs.com.

NOTES

Appendix D: Transportation & Shipping

This chapter covers the following topics and tasks:

- ✓ U.S. Shipping Requirements
- ✓ Canadian Shipping Requirements

U.S. Shipping Requirements

The U.S. DOT hazmat regulations (49 CFR, Parts 100–185) apply any time a nuclear device is transported by motor vehicle on a public highway or by other means of transport (rail, air, ship).

The major requirements for transporting a nuclear gauge in the United States are listed below. For more detailed information about these requirements, please refer to the *Troxler Transportation Guide*.

A copy of the current IAEA Certificate of Competent Authority for each source in the gauge (Special Form Certificate) must be kept on file. Current versions are available on the Troxler website at www.troxlerlabs.com.

- A copy of the results of the "TYPE A" package testing must be on file.
- Hazmat employee training records must be kept on file.
- An "Emergency Response Information" document must be in the vehicle and immediately accessible to the driver.
- A properly completed "Bill of Lading" must be in the vehicle and immediately accessible to the driver. The shipping papers must include a 24-hour emergency response telephone number.
- If shipping by air, a "Shipper's Declaration for Dangerous Goods" must accompany the air waybill.
- The package must be properly marked and labeled in accordance with hazmat regulations.
- The package must have a tamper-evident seal.
- The package must be inspected prior to each shipment.
- The package must be securely blocked and braced in the vehicle to prevent shifting during transport.

Accident Notification Requirements

In the event of a reportable incident involving radioactive material, notify the licensing agency as soon as practical. The operator is also required to notify, at the earliest practical moment, the U.S. DOT at 1-800-424-8802 of an accident that occurs during the course of transportation (including loading, unloading, and temporary storage) in which fire, breakage, spillage, or suspected contamination occurs involving shipment of radioactive materials.

Hazmat Training

The U.S. DOT regulations require every hazmat employer to train, test, certify, and maintain records for each hazmat employee. Hazmat training applies to anyone who transports or prepares for transport radioactive materials per 49 CFR 172 subpart H. Refresher training is required every three years. Visit our website at www.troxlerlabs.com for more information about Troxler's Hazmat Refresher training course.

Canadian Shipping Requirements

The Transportation of Dangerous Goods Act and Regulations (TDG) and Transport Packaging of Radioactive Materials Regulations (TPRM) apply any time a nuclear device used in commerce is transported by any means in Canada.

For training and accident notification requirements, consult the Transportation of Dangerous Goods Regulations. For further information on transporting a nuclear device, contact the transportation section of the Canadian Nuclear Safety Commission (CNSC).

Appendix E: Special Calibration Samples

This chapter covers the following topics and tasks:

- ✓ Preparing special calibration samples

Sealed Asphalt Samples

To prepare sealed asphalt samples follow the procedure below:

1. Fill the sample pan to within 0.25 inches of the top. Refer to Chapter 4 for preparing calibration samples.
2. Apply a bead of "siliconized acrylic latex caulk" around the edge of the asphalt sample pan.
3. Place the 0.032 in (1 mm) aluminum cover plate down on top of the caulking. Gently press down to seal the sample.
4. Spread a bead of caulk around the edge of the pan on top of the plate.
5. Inspect the sample and seal any visible gaps, cracks or holes.

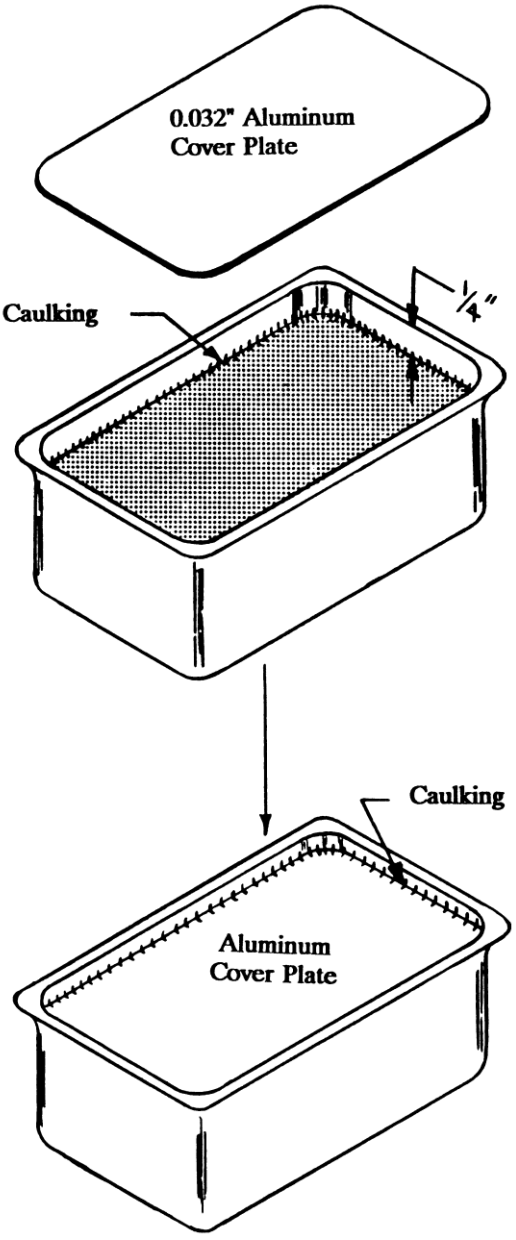


Figure 15. Sealed Asphalt Sample

NOTES

Appendix F: Calibration Forms

This chapter covers the following topics and tasks:

- ✓ Calibration sample preparation forms

CALIBRATION TEST RECORD

GAUGE MODEL _____ SERIAL NO. _____ DATE _____ REF_____

PROJECT _____ LOCATION_____

Aggregate:

SOURCE	SIZE	AMOUNT

Asphalt:

SOURCE	TYPE	GRADE

Background Count _____

		Blank Sample
1	Empty Pan Weight	
2	Weight of Pan + Aggr	
3	Blank Smpl Wt. (2-1)	

	Calibration Coefficients
A1 =	
A2 =	
A3 =	

		Pan 1	Pan 2	Pan 3	Pan 4	Pan 5	Pan 6
A	Desired AC %						
B	Mixing bowl Weight						
C	Dry Aggregate Weight						
D	Subtotal (B+C)						
E	Total Design Weight						
F	Total Actual Weight						
G	Actual AC %						
H	Calib. Pan Weight						
J	Aggr + Asphlt Weight						
K	Gross Weight (H+J)						
L	Asphalt Content (%AC)						
M	Counts (MC)						

Calibration Data Sheet

NUCLEAR ASPHALT CONTENT GAUGE
w/ PAN METHOD

Calib. # _____ Date: _____

Mix Type: _____ Mix ID: _____

Project: _____

Background (16 minutes): _____						
Aggregate Only Sample Count (16 minutes): _____						
16 MIN.CNTS	1	2	3	4	5	CHECK
% AC						
COUNT:						

Pan Weight						

Fit Coeff: _____	
A1:	Diff 1:
A2:	Diff 2:
A3:	Diff 3:
	Diff 4:
	Diff 5:

TROXLER ELECTRONIC LABORATORIES, INC.
P.O. Box 12057, R.T.P., N.C. 27709

Figure 16. Calibration Data Sheet

INDEX

%AC 4-5

AASHTO standards 4-3
Accessories 1-3, C-8
Accidental Erasure ..... *See* Recover Erase
Activity, source A-3
Adapter, power B-7
Americium-24:Beryllium A-13
ASTM standards 1-2
Atomic structure A-2
Auto-Print 6-8
Auto-Store 6-8

Background count 3-7
Batteries C-6
Baud Rate 7-14
Becquerel A-4

Calculator 6-11
Calibration
- Cross Calibration 7-8
- Equipment 4-2
- Forms F-1
- Manually entering data 4-16
- Offset 6-4
- Performing 4-10
- Reviewing 4-14
- Sample mixing 4-5, 4-6
- Sample preparation 4-3, 6-12
- Transfer 7-7

Charging Batteries C-6
Computer 5-5
Count time 3-4
Cross Calibration 7-8
Curie A-4
Customer name 3-6

Date, changing 3-5
Detectors 2-2, C-7
Dosimetry A-5
Drift test 7-4
Electrical specifications B-4

Erase
  Calibration 6-9
  Project 5-6, 6-9
  Recover 7-6

Gauge weight B-5

High voltage B-7
Hydrogen 2-2

Incorrect readings C-4
Interface
  Computer B-4
  Printer B-4

Leak testing A-5

mCi A-4
Measurement
  Incorrect C-4
  Sample preparation 3-8
  Specifications B-2
  Store 5-4
  Taking 3-9
Mechanical specifications B-5
Memory B-4

Number, maximum
  Calibration files B-4
  Test data files B-4

Offset function 6-4
Operating temperature B-5
Operational theory 2-2
Optional equipment C-8

Pan
  Sample D-7
  Sealed sample D-2
  Weight display 7-16
Parts
  Gauge 1-3
  Replacement C-7
Print function 5-5
Printer, optional 1-4, C-7
Project function 5-2

Quantity, source A-3

Rad A-4
Radiation
  Safety A-7
  Statistics A-5
  Terminology A-4
  Theory A-2, A-4
  Types A-7
Radiation Profile
  100 mCi A-10
  300 mCi A-11
  80 mCi A-12
Radiological specifications A-3
RAM B-4
Recall function 6-10
Recover erase 7-6
Rem A-4
Replacement parts C-7
Requirements, shipping D-2
ROM B-4

Sample
Blank....4-3
Calibration....4-3
Filling....4-9
Mixing....4-5
Preparation....3-8

Samples
Pan....E-7
Sealed....E-2
Self-Test
Failure....C-2
Serial Number function....7-15
Service
Returning gauge....B–9
Set-up, gauge....3-4
Shift functions....6-2
Shipping
Requirements....D-2
Shipping forms....D-9
Site selection....1-6
Size, gauge....B-5
Software....C-4
Source....A-3
Encapsulation....A-13
Source activity....A-3
Special functions....7-1
Specifications
Electrical....B-4
Measurement....B-2
Mechanical....B-5
Radiological....B-3
Standards
AASHTO....4-3
ASTM....1-2
Stat test....7-2
Status function....6-3
Store function....5-4

Target precision 6-10
Temperature, operating B-5
Theory, operational 2-2
Time
  Changing 3-5
  Count 3-4
Time/Date 3-5
TLD A-5
Training
  Hazmat A-3
  Nuclear Gauge Safety 1-2, A-2
Transfer calibration 7-7
Troubleshooting C-2

Unpacking and inspection 1-4
Upload Data to a Computer 5-5

Weight, gauge B-5

TROXLER ELECTRONIC LABORATORIES, INC.

LIMITED WARRANTY

TROXLER ELECTRONIC LABORATORIES, INC., and subsidiary, TROXLER INTERNATIONAL, LTD., hereinafter referred to as "TROXLER," warrants this instrument, Model 3241-___, Serial Number _____, against defects in material and workmanship for a period of twelve (12) months from date of shipment. For products sold through authorized TROXLER representatives, the date of shipment will be as of the transfer from representative to purchaser. During the applicable warranty period, TROXLER's obligation under this warranty shall be limited exclusively to the repair at a TROXLER facility at no charge, except for shipping to and from TROXLER'S plant, of any instrument which may prove defective under normal use and which TROXLER's examination shall disclose to its satisfaction to be thus defective. Normal use is defined for the purpose of this warranty as operation under normal load, usage, and conditions with proper care and maintenance and competent supervision. In no event shall TROXLER be held liable for damages, delays, or losses consequential, incidental, or otherwise attributable to the failure of this instrument. TROXLER's liability being specifically limited to repair as stated hereinabove. This warranty is automatically initiated except where modified by contractual or other written and signed agreement.

THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF, AND THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, AND TROXLER NEITHER ASSUMES, NOR AUTHORIZES ANYONE TO ASSUME FOR IT ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF THE INSTRUMENT. THIS WARRANTY SHALL NOT APPLY TO THE INSTRUMENT OR ANY PART THEREOF, WHICH HAS BEEN SUBJECTED TO DAMAGE BY ACCIDENT, NEGLIGENCE, ALTERATION, ABUSE, MISUSE, OR SERVICE NOT AUTHORIZED IN WRITING BY TROXLER. SUCH DAMAGE TO INCLUDE BUT NOT BE LIMITED TO BURNING OF CIRCUIT BOARDS AND HARNESS FROM IMPROPER SOLDERING TECHNIQUES AND DAMAGE TO THE INSTRUMENT DUE TO PURCHASER'S FAILURE TO PERFORM MAINTENANCE AS OUTLINED IN THE AUTHORIZED OPERATOR'S MANUAL. DUE TO THE NATURE OF THEIR USE, MECHANICAL ACCESSORY PARTS AND BATTERIES ARE WARRANTED FOR 90 DAYS ONLY FROM DATE OF SHIPMENT.

TROXLER ELECTRONIC LABORATORIES, INC.
3008 E. Cornwallis Road
Post Office Box 12057
Research Triangle Park, NC 27709 U.S.A

NOTICE TO CONSUMERS

Any disclaimer or limitation on the remedies expressed above shall not be effective to the extent prohibited by state or federal law.

NOTE: THIS WARRANTY EXCLUDES DAMAGE INCURRED IN SHIPMENT. IF THIS INSTRUMENT IS RECEIVED IN DAMAGED CONDITION, THE CARRIER SHOULD BE CONTACTED IMMEDIATELY. ALL CLAIMS FOR DAMAGE IN TRANSIT SHOULD BE FILED WITH THE CARRIER. IF REQUESTED, TROXLER WILL AID IN FILING OF CLAIMS AND/OR LOCATING PRODUCTS LOST IN TRANSIT.